THE LIMITS OF DECENTRALIZED EXECUTION:

THE EFFECTS OF TECHNOLOGY ON A CENTRAL AIRPOWER TENET

BY

MUSTAFA R. KOPRUCU

A THESIS PRESENTED TO THE FACULTY OF

THE SCHOOL OF ADVANCED AIRPOWER STUDIES

FOR COMPLETION OF GRADUATE REQUIREMENTS

SCHOOL OF ADVANCED AIRPOWER STUDIES

AIR UNIVERSITY

MAXWELL AIR FORCE BASE, ALABAMA

JUNE 2001

Report Documentation Page

Report Date	Report Type	Dates Covered (from... to)
01JUN2001	N/A	-

Title and Subtitle The Limits of Decentralized Execution: The Effects of Technology on a Central Airpower Tenet	**Contract Number**
	Grant Number
	Program Element Number
Author(s) Koprucu, Mustafa R.	**Project Number**
	Task Number
	Work Unit Number
Performing Organization Name(s) and Address(es) School of Advanced Airpower Studies Air University Maxwell AFB, AL	**Performing Organization Report Number**
Sponsoring/Monitoring Agency Name(s) and Address(es)	**Sponsor/Monitor's Acronym(s)**
	Sponsor/Monitor's Report Number(s)
Distribution/Availability Statement Approved for public release, distribution unlimited	
Supplementary Notes The original document contains color images.	
Abstract	
Subject Terms	
Report Classification unclassified	**Classification of this page** unclassified
Classification of Abstract unclassified	**Limitation of Abstract** UU
Number of Pages 92	

Disclaimer

The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the US Government, Department of Defense, the United States Air Force, or Air University.

About the Author

Major Mustafa "KUJO" Koprucu earned his commission through Officer Training School in 1988 after graduating from Columbia University. After completing Undergraduate Controller Training at Tyndall AFB, FL and Luke AFB, AZ, he was assigned to the 552nd Airborne Warning and Control Wing at Tinker AFB, OK. He flew as a weapons director during Operations Desert Shield and Desert Storm, directing two MiG-25 kills and assisting in six others during the war. In 1995 he was assigned to Melbourne, FL where he participated in the Multi-Service Operational Test and Evaluation (MOT&E) of the Joint Surveillance Target Attack Radar System aircraft. The MOT&E was conducted during an operational deployment in support of Operation Joint Endeavor, the NATO peacekeeping missions into Bosnia-Herzegovina. In 1996 he was assigned to the 93rd Air Control Wing at Robins AFB, GA participating in numerous deployments culminating with Operation Allied Force. Major Koprucu attended Air Command and Staff College in 2000 and was chosen for the School of Advanced Airpower Studies Class of 2001. Following graduation, Major Koprucu was assigned to the Air Staff's Checkmate Division.

Acknowledgments

I owe a debt of gratitude to many individuals throughout my time in the Air Force for assisting me in formulating the ideas that are put forth in this paper. Most recently, I am indebted to the faculty of the School of Advanced Airpower Studies for the excellent curriculum it has established and the first-class group of professors who have certainly opened my eyes to the potentials of airpower, its limitations, and its history.

In equal measure, I owe thanks to my fellow SAAS, and previous-year ACSC, students for two full years of discussions on a variety of topics that have educated me on how to think and formulate ideas about airpower.

But more than all of the above, I owe my wife Lewanna, my two sons Mustafa and Konrad, and my parents immeasurable thanks for the years of support and understanding they have given me in getting to this point. Without all they have provided during the past years, and their patient acceptance of my time away from them to complete this project, readers would not have this copy in front of them now.

Abstract

This thesis investigates the effects of technological advances on decentralized execution of air operations. It specifically seeks to answer the question of how advanced sensor and communication capabilities in Air Operations Centers might lead to centralized execution.

The research focuses on three case studies of air operations: Linebacker II, Desert Storm, and Allied Force. In each case the command-and-control structure for air operations is analyzed, the command-and-control systems are described, the technologies enabling the air commanders headquarters to maintain real-time control of his forces are evaluated; and the influence of all these factors on decentralized execution are assessed.

The study concludes that technological advances in Air Operations Centers' ability to receive real-time information on on-going air missions and situational displays that give it detailed information on local conditions in the battle area, combined with a concurrent capability to communicate with strike aircraft, makes centralized execution feasible. Under certain conditions of limited force application with a high degree of political control, centralized execution may also become desirable.

Finally, the implications of these technological advances for future Air Operations Centers, which have been designated by the USAF as weapons systems, are discussed within the context of enabling information superiority.

Contents

Illustrations

Chapter 1

INTRODUCTION

Decentralized execution of air operations has been a tenet of United States airpower since 1971. Air Force Manual (AFM) 1-1 of that year contained the first written use of the term in doctrine. In every subsequent edition of AFM 1-1, as well as its current version as Air Force Doctrine Document 1 (AFDD-1), basic aerospace operations are described as best conducted via centralized control and decentralized execution.

Centralized control, the idea that all theater air operations should be commanded by a single airman, has a history stretching back as far as Billy Mitchell's assumption of command of all Air Service tactical and strategic air units in the American Expeditionary Forces' (AEF) Zone of Advance in 1917.[1] In December 1917 Mitchell, as the Corps Air Service Commander, took control of all air service units in the AEF. Not until 1943 and the publication of FM 100-20, *Command and Employment of Air Power*, however, was the concept of centralized control of theater airpower by a single airmen codified into doctrine. In describing the importance of centralized control under one Air Force commander, FM 100-20 stressed that airpower's full potential for flexibility in delivering a decisive blow could be fully exploited only under this key command relationship.[2] From that day onward, airmen have heralded centralized control of theater airpower as the essential first step towards its effective command.

Not until 1971, however, was the concept of decentralized control and execution written into doctrine. In the 1971 edition of AFM 1-1, centralized allocation and direction became linked with decentralized control and execution as the fundamental

---

[1] *The US Air Service in World War I, Vol. II*. (Washington D.C.: US Government Printing Office, 1978), 139, 165.

[2] War Department Field Manual 100-20, *Command and Employment of Air Power* (War Department 21 July 1943), 2.

operating principles in the employment of airpower:

> To realize the full potential of these characteristics, aerospace forces must be centrally allocated and directed at a level which permits exploitation of diverse capabilities in support of overall objectives. Concurrently, mission control and execution of specific tasks must be decentralized to a level which permits maximum responsiveness to local conditions and requirements. These complementary concepts—*centralized allocation and direction and decentralized control and execution*—are fundamental to the effective application of aerospace power.[3] (Italics added)

Subsequent editions of AFM 1-1 linked these concepts into the now familiar dictum, centralized control and decentralized execution. In 1975, the terms became essential ingredients for successful action, "The basic principles of centralized control, decentralized execution, and coordinated effort are fundamental to the success of aerospace operations."[4] Grouped under the heading of Command and Control (C2), the principles became associated with C2 structures and systems. The manuals did not, however, stipulate how these terms applied to various echelons of command. The term decentralized execution was not clarified until 1979.

The 1979 edition of AFM 1-1 split the terms into their individual components and expanded discussion of their characteristics:

> Under the principle of decentralized execution, higher echelons of command define missions and tasks, and then direct lower echelons to conduct the operations. This principle allows lower echelon commanders to maintain a responsive and effective force and frees high echelon commanders to focus aerospace power on achieving overall mission objectives. This arrangement in no way limits the operational commander's authority nor lessens his responsibility; it places details for mission planning at the action level.
>
> *At the same time, higher echelon commanders must ensure that the capabilities of their forces are not exceeded. This philosophy is required because a single commander cannot personally direct all of the detailed actions of a large number of air units or individuals* [5] (Italics in original)

For the first time, doctrine codified the relationship between superior and subordinate

---

[3] Air Force Manual 1-1, *United States Air Force Basic Doctrine*, 28 September 1971, 2-1.

[4] Air Force Manual 1-1, *United States Air Force Basic Doctrine*, 15 January 1975, 3-1.

[5] Air Force Manual 1-1, *Functions and Basic Doctrine of the United States Air Force*, 14 February 1979, 5-2.

commanders involved in decentralized execution and gave the reasoning behind the adoption of this principle. Higher echelons provided direction, the "what to do," while lower echelons determined the "how to do it." AFM 1-1 went on to state:

> This heritage produces leaders who are able to trust the commanders and individual members of our armed forces to make good decisions and to perform to the best of their abilities. This is an organizational strength that must be maintained. This aspect of our national character makes possible the rapid action-and-reaction that is not found in highly centralized societies. Decentralized execution allows for the wider use of judgement in employing the capabilities and characteristics of warfare systems.[6]

Linked to our national character as a democratic people, decentralized execution became a key tenet of our command and control philosophy by harnessing the initiative of lower echelon commanders in the conduct of an air campaign, while maintaining overall broad guidance and direction from above. This philosophy is very much in line with the concept of mission-type orders and the *Auftragstaktik* philosophy of the German military from the time of Helmut Von Moltke onward, concepts which will be defined and expanded in Chapter 2.

In tracing the doctrinal development of decentralized execution, the March 1984 edition of AFM 1-1 allots a scant half sentence to the term stating that it "provides the flexibility for subordinate commanders to use ingenuity and initiative in attacking targets."[7] Eight years later, the seminal 2-volume edition AFM 1-1 provided the clearest discussion of the problems faced in balancing centralized control with decentralized execution. That balance, an underlying concern throughout this thesis, and the levels at which control is centralized and execution dispersed, are of fundamental importance in understanding this tenet. Volume II of the 1992 1-1 suggested that decentralized execution first appeared in the 1971 AFM 1-1 as a reaction against the extensive control exerted by the Johnson administration in the bombing campaign against North Vietnam. In effect Johnson exercised centralized control at the highest level of government and left

---

[6] Ibid., 5-3.

[7] Air Force Manual 1-1, *Functions and Basic Doctrine of the United States Air Force*, 16 March 1984, 2-21.

little flexibility to on-scene commanders in theater to respond to local conditions.[8] AFM 1-1 went on to state that:

> Since 1943 the most vexing control issue has been the level at which control should be centralized, including the question as to whether all aerospace power (Air Force, Army Navy, and Marine Corps) should fall under a single aerospace component commander. Too much or too little centralization has proved counterproductive, the former delaying responsiveness and the latter leading to dissipation of effort…
>
> The complementary concept of decentralized execution also raises some thorny problems. Modern technologies seem to make decentralization of many important decisions increasingly inappropriate or even unnecessary…
>
> Still, success in war at the tactical level requires attention to details and the ability to adapt quickly to exploit fleeting opportunities. Although centralized control can effectively concentrate aerospace power within a campaign, commanders exercising such control are likely to be faced with too many units and too little time to make timely adjustments for tactical effectiveness…
>
> Decentralized execution answers these problems in span of control and survivability. In many cases, beginning in World War II, those exercising centralized control of air forces have defined areas of responsibility, assigned tasks and command of forces, and delegated authority for execution to subordinate air echelons. These subordinate air echelons have been responsible for supervising the details and making the rapid adaptations that lead to tactical success.[9]

At the operational, or campaign, level of war, centralized control and decentralized execution work together allowing commanders to balance the requirement to make theater airpower responsive to emerging conditions and opportunities, while delegating the details of mission accomplishment, i.e. execution, to an appropriate lower level in order to reduce span of control.

The 1992 doctrinal manual briefly observeed that technology might make decentralization of some decisions inappropriate or even unnecessary. As air operations

---

[8] Air Force Manual 1-1, *Basic Aerospace Doctrine of the United States Air Force, Vol. II*, March 1992, 114

[9] Ibid., 114-115.

take place from widely dispersed bases, and intelligence and threat information become concentrated in a single air operations center, many of the decisions that required delegation to lower levels might indeed become better made at higher echelons. This thesis will expand on and examine that proposition in detail after concluding discussion on the doctrinal development of decentralized execution.

In 1997 Air Force Doctrine Document 1 superceded the Air Force Manuals of the past and became the basic operational-level doctrine for the service. It stated, as did its predecessors, that centralized control and decentralized execution were critical operating tenets for successful airpower employment. AFDD-1 described how decentralized execution as, "delegation of execution authority to lower-level commanders is essential to achieve effective span of control and to foster initiative, situational responsiveness, and tactical flexibility."[10] This edition did not provide much more information on the concept of decentralized execution than did either the 1975 or 1984 AFM 1-1.

In summary, doctrinal descriptions of one of the fundamental tenets of airpower, decentralized execution, have ranged from the appropriate delegation of mission tasks to re-affirming our fundamental belief as a nation in the initiative of its soldiers. Part of the tenet of centralized control, and as such, an important aspect of understanding and using this principle in the field is finding the right balance between the centralization of command and the dispersal of execution. Information may be the key determinant in adjusting this balance.

Scope and Methodology of This Study

This study examines the validity of the central airpower tenet of decentralized execution in light of the technological advances in command and control systems, within the context of the organizational command-and-control structure in within the theater. Specifically this thesis seeks to answer the question of whether or not sensor and communications technologies might make some aspects of airpower employment better accomplished via centralized execution. As advances in surveillance and intelligence information become increasingly concentrated in a single air operations center that has

[10] Air Force Doctrine Document 1-1, *Air Force Basic Doctrine*, September 1997, 23.

tasking authority over all air assets in a theater, and as communications technology allows the air component commander to communicate directly with every aircraft involved in executing the air campaign, does decentralized execution remain a viable tenet?

This study first examines several theoretical aspects in the evolution of modern command and control theory. Chapter 2 will trace the evolution of command and control of large-scale forces beginning with the end of the Napoleonic era. Concepts such as *Auftragstaktik* and mission-type orders, fundamental aspects of decentralization in campaigns, will be examined and the later applicability of these concepts to air operations will be traced.

Following the theoretical and historical grounding of modern command and control theory, three specific case studies will examine the employment of decentralized execution to air operations. Specifically, each chapter will examine an air operation and the associated command and control technologies in place and assess the degree to which operations were decentralized, and whether or not the C2 architecture supported this, or in fact led to more centralized execution. Chapter 3 will examine the Linebacker campaigns in 1972-1973. Chapter 4 will examine Desert Storm air operations and the advances in both technology and operating concepts to assess how technology supported decentralization or precluded it in 1991. Finally chapter 6 will examine the most recent command-and-control technologies used during operation Allied Force. This thesis will conclude discussing the impact of technologies on modern Air Operations Centers (AOC) and with and an assessment of the current state of the art and concepts of operation (CONOPS).

Limitations of This Study

This study will primarily explore the tenet of decentralized execution at the operational level of war, that is at the theater level. As AFM 1-1 of 1992 stated earlier, "since 1943 the most vexing control issue has been the level at which control should be centralized." One of the problems in this type of study is that of perspective; what might seem decentralized to a theater level commander might from the cockpit of a strike aircraft seem overly centralized. Close Air Support (CAS) operations are one such

example. In many theaters a C2 architecture responsive to the needs of a ground commander allows CAS requests to filter up from ground units very quickly and appropriate air resources to be allocated to the particular mission without the intervention of an AOC. The AOC typically allocates a certain number of CAS missions in the daily Air Tasking Order (ATO) to various air units. A lower command level, typically an Air Support Operations Group (ASOG), then matches CAS requests to sorties. From the perspective of a CAS aircraft, the operations are actually fairly centralized. Ground controllers give the CAS aircraft not only its tasking, but many other details on how to accomplish its mission, such as ingress route, altitude, threats, and deconfliction with friendly ground forces. From the perspective of the air commander at the AOC, this process is decentralized to the point that lower echelons make all the necessary decisions. Since much of current Air Force doctrine is written for the operational level of war, the perspective of this study will also derive its viewpoint from that of an operational-level air commander.

Additionally, the subject of command and leadership can often become a matter of personality and individual style, regardless of what is written in doctrine. While personalities matter, C2 systems are designed for standardized use regardless of operating theater or personality. Although commanders can and will tailor systems for their individual command styles, this study will examine air operations independent of the personality of the commander involved by concentrating on the level of decentralization of the air operations.

Finally, this thesis establishes a criterion and useable definition of decentralized execution from which the operations will be examined. What all the doctrinal descriptions of decentralized execution hold in common is a fundamental assertion that the higher echelons of command concentrate on broader operational concepts involving *what* the air campaign should accomplish. These involve such issues as priority of effort, targeting, and the force structure required in theater to deliver a desired capability for the campaign. After the JFACC determines the targeting strategy, mission accomplishment is delegated to a lower level. Lower echelons decide *how* to accomplish the mission by planning munitions loads, ingress and egress routing, etc. This thesis defines execution, a term not defined doctrinally, as those actions taken to accomplish a mission, after a

higher echelon assigns it to a unit.

By tracing the evolution of C2 systems from the 19th century to the present, this paper seeks to demonstrate that technological advances serve to increase the centralization of air campaign execution. Technologies increase the ability of the Air Operations Center to monitor the progress of aircraft once they have launched on their missions and enables re-tasking and diversion from their originally assigned missions. Centralized execution then becomes the ability of a single air commander, and his respective operations center, to directly monitor and control the execution of an air campaign while it is in progress.

The key concept in determining the level of centralization of execution thus becomes the level from which decision making authority is or is not delegated. In a purely decentralized system, the decision making authority on all aspects of conducting a mission are in the domain of the operator assigned that task, with little direction from higher echelons. As the C2 structure moves towards more centralized execution, higher echelons exert increasing authority over more aspects of the mission's execution.[11]

---

[11] For a detailed discussion see, David K. Gerber, *Adaptive Command and Control of Theater Airpower*, (Maxwell AFB, AL: Air University Press, 1999), 4-7.

Chapter 2

ESSENCE OF COMMAND AND CONTROL

Where, oh where are the good old days of the simple wars when, as the hour of the battle approached, the commander got on his white horse, someone blew the trumpet, and off he charged towards the enemy?

Moshe Dayan

At the very heart of command is the idea that those exercising it have the inherent authority to issue orders to subordinates. Joint Pub 1-2 defines command as, "the authority that a commander in the Armed Forces lawfully exercises over subordinates by virtue of rank or assignment."[12] But this definition leaves an important question unanswered; after a commander issues his orders, how does he ensure that they were in fact obeyed, or change the actions of those forces once they begin to execute their mission? If he has not implemented any control measures, he has no feedback system with which to adjust the direction of his forces once they have begun execution of their initial orders. Command and control systems achieve this feedback between a commander and his forces. C2 systems allow a commander to monitor the actions of his forces and to issue follow-on commands to those forces in a timely manner.[13] Joint doctrine defines command and control as, "the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission."[14] Current Air Force doctrine states, "C2 includes both the process by which the commander decides what action is to be taken and the system which monitors the implementation of the decision."[15] Marine Corps doctrine, however, provides perhaps the most succinct definition of Command and Control as, "the means by which a

---

[12] JCS Pub 1-02, *DOD Dictionary of Military and Associated Terms*, 12 April 2001, 79.

[13] Robert L. Edge, "Command and Control Systems: What are They? Who Needs Them?," in *Issues in C3I Program Management*, ed. by Jon L. Boyes (Washington DC: AFCEA International Press, 1984), 5.

[14] JCS Pub 1-02, 79-80.

[15] AFDD-1, 53-54.

commander recognizes what needs to be done and sees to it that appropriate actions are taken."[16]

Historical Background

Moshe Dayan's wistful dream of simpler days when generals led their troops from the front notwithstanding, prior to the advent of electronic communications, military commanders often sought advantageous positions on high ground from which they could surveil their battleground, if not directly participate in the fighting. By instituting communication systems of flags, trumpets, runners and other measures, commanders maintained a larger perspective of the entire battlefield and maintained control of their forces over a large area. Some, such as Hannibal at Cannae, maintained control over much larger formations even while themselves engaged in the thickest of the fighting. While leading his men holding the weakened center against Varro's Roman Legions, Hannibal personally ordered the withdrawal of the center line and gave the signal for the wings to turn inward, thus enveloping the legions in one of Rome's most crushing defeats.[17]

Martin van Creveld calls this period "the stone age of command." Problems of slow, long-range communication, compounded with other problems of inadequate roads, inaccurate maps of foreign terrain, and the inability to measure time precisely while on the move, predisposed commanders against dividing their forces beyond a range from which they could be controlled visually.[18] Independent units, capable of acting autonomously, yet still under the overall charge of a single commander, were extremely rare and consisted almost exclusively of small units used only in tactical situations.[19]

In the 18th century, as Europe's road network developed, so too did advances in cartography; and a general increase in land productivity also made it possible to support

---

[16] MCDP 6, *Command and Control* (Washington D.C.: US Government Printing Office, 1996), 37.

[17] Thomas E. Griess, *Ancient and Medieval Warfare* (Wayne, NJ: Avery Publishing Group, 1984), 58.

[18] Martin van Creveld, *Command in War* (Cambridge, MA: Harvard University Press, 1985), 26.

[19] Ibid., 24.

larger armies, which concurrently decreased reliance on the system of depots and magazines for mobility.[20] These structural changes allowed armies not only to grow in size, but further required the establishment of staff organizations to manage logistics, long-range plans, intelligence collection and correlation, maintenance functions (both of animals and machines), legal and even personnel issues. By the end of the 18th century, a revolutionary change also occurred in the organization of armies.

Napoleon

When Napoleon organized his army into semi-independent corps, capable of both sustaining themselves in the field and fighting autonomously for approximately 24 hours, a significant change occurred in the conduct of war. A centralized Imperial Staff, under Napoleon's own personal direction, managed the strategic movements of the various corps of the *grand armée*. Each corps, and divisions below it, in turn had its own staff to manage its day-to-day functions. The corps and divisions themselves were fairly uniform and similarly equipped, functioning as interchangeable parts in the larger force of the army. Any one corps could give battle, defending itself long enough for a reinforcing corps to arrive within a day's march.

Under Napoleon's direction, the corps traveled and dispersed across the countryside, thereby preventing enemy forces from discerning the actual size and intentions of his army.[21] Using a centralized command system, he planned in great detail the positions of his corps throughout the area of operations and could concentrate them upon an enemy by timing their arrival upon the battlefield from various directions to annihilate the opposing force. Despite this centralization, Van Creveld's analysis of Napoleon's victory at Jena-Auerstadt gives convincing evidence that the success there was due mostly to the effectively decentralized nature of the organization that Napoleon had created.[22]

Napoleon himself exerted extreme control over all aspects of his army's activities. The Imperial Staff that he created, the organization of his army into similarly equipped

---

[20] Ibid., 60.

[21] David G. Chandler, *The Campaigns of Napoleon* (New York: MacMillan, 1996), 153.

[22] Van Creveld, *Command in War*, XXXX

corps, and the up-and-down flow of information that informed the staffs on the status of the army were all results of Napoleon's efforts. During the Battle of Jena-Auerstadt, Napoleon was tireless in his efforts to ensure that his forces were deployed properly, concentrating his attention on the Prussian armies in the vicinity of Jena, which he took to be the main Prussian force. Not until after the battle, however, did he realize that his 3rd Corps to the North had, in fact, encountered the retreating Prussian main force and had beaten them decisively there at Auerstadt without any further guidance from the Imperial Staff.[23]

Van Creveld's analysis shows that army's had become too large for any one commander to have sufficient situational awareness of the battlefield. In spite of Napoleon's efforts to maintain a totally centralized system of command and control over his forces, by creating semi-independent units, he had, in fact, decentralized operations and had thereby made his forces that much more capable of operating over a large area. By decentralizing operations, and tolerating a higher degree of uncertainty at the top, Napoleon effectively created a fighting force that could act over a much larger area than his opponents' armies that had to respond in unison to the commands of a single leader. The 24-hour period during which units could fight autonomously allowed Napoleon to control forces and operate over a much larger are than could contemporary commanders. The tolerance for uncertainty at the top will become a key concept in discussing command and control systems later.

The consequences of Napoleon's decentralized execution, however, were totally unintended. Napoleon's tendency was to exert centralized control and execution over his forces and not to rely on the initiative of subordinates. As Peter Paret notes of Napoleon:

> Neither in Russia nor in the spring and fall campaigns of 1813 in Germany could his marshals be counted on to interpret his orders in accord with the constantly changing situation. He would never have tolerated the peculiar combination of independence and subordination on the part of separate army commands that might have successfully directed hundreds of thousands of troops against strong opposition over vast distances. Even such a system, to be sure, would have been handicapped by the crude

[23] *Ibid.,* 85-95.

means of communication of the time.[24]

The effects of his campaigns provided fodder for military analysts for decades to come. As Napoleon demonstrated that ever-larger armies could take to the field, so too his successors sought the best system of command and control over those ever larger forces.

Auftragstaktik

With the fall of Paris in 1814 and the end of the Battle of Waterloo the next year, Napoleon's threat to Europe finally had ended. During the relative peace of the ensuing fifty years, subsequent to the Congress of Vienna and during the Concert of Europe, a period without large-scale war kept the great powers in balance. Rising nationalism in Europe after 1848 began to disturb the stability, until eventually Bismarck, the chancellor of Prussia, exploited German nationalism to create a unified Germany in 1871.

During the same period, great technological advances also took place. Railways not only allowed rapid mobilization of troops, but could also concentrate them on the battlefield. As Hajo Holborn notes:

> The railroads offered new strategic opportunities. Troops could be transported six times as fast as Napoleon had marched, and the fundamentals of strategy—time and space—appeared in a new light. A country that had a highly developed system of rail communications gained important and possibly decisive advantages in warfare. The speed of mobilization and of the concentration of armies became an essential factor in strategic calculations.[25]

Railroads allowed planners to concentrate troops at desired locations. Early experiments in mobilizing troops via rail occurred soon after the first appearances of railways in Germany in 1835 when the Prussian General Staff began to study the potential of rail mobilization.[26] By 1857, when Wilhelm I of Prussia appointed Helmut

---

[24] Peter Paret, "Napoleon and the Revolution in War," in *Makers of Modern Strategy from Machiavelli to the Nuclear Age*, ed. Peter Paret (Princeton NJ: Princeton University Press, 1986), 137.

[25] Hajo Holborn, "The Prusso-German School: Moltke and the Rise of the General Staff," in *Makers of Modern Strategy from Machiavelli to the Nuclear Age*, ed. Peter Paret (Princeton NJ: Princeton University Press, 1986), 287.

[26] Trevor N. Dupuy, *A Genius for War: The German Army and General Staff, 1807-1945* (Fairfax, VA: Hero Books, 1984), 50.

von Moltke as Chief of the General Staff, a separate railways department had existed already as a permanent organization on the staff. In 1859 France moved 120,000 troops into Italy in 11 days, a feat that would previously have taken two months if they had marched on foot.[27] Lessons learned from observers about the United States' use of rail transport during the Civil War confirmed its efficacy in battle. By 1866, Moltke had organized the rail system for the mobilization of Prussian forces to the extent that large concentrations of troops could deploy to Königgrätz on five railway lines against the Austrians' one, while concurrently developing the means to communicate their orders from the rear.[28]

In 1848 the Prussian railway service first used the electric telegraph system to communicate orders, and within five years this success drove it to expand telegraph capability throughout the kingdom.[29] The potential of telegraphs to command armies in the field became a matter of debate within the Prussian army, with most officers fearful that constant supervision from higher headquarters would stifle initiative at the lower levels. Indeed, the relationship between the sovereign's political power and the military commander in the field was an association whose nature had been theorized only recently by Carl von Clausewitz's famous dictum that, "war is merely the continuation of policy by other means."[30] Moltke accepted Clausewitz's basic premise, but he added his own modifications to that relationship during times of war:

> …strategy is independent of policy as much as possible. Policy must not be allowed to interfere in operations.[31]
>
> Policy uses war for the attainment of its goals: it works decisively at the beginning and the end of war, so that indeed policy reserves for itself the right to increase its demands or to be satisfied with a lesser success.

---

[27] Michael Howard, W*ar in European History*, (Oxford: Oxford university Press, 1976), 07.

[28] See Dennis Showalter, "The Influence of Railroads on Prussian Planning for the Seven Weeks' War," *Military Affairs* Vol. 38, no. 2 (April 1974), 62-67.

[29] Dennis Showalter, "Soldiers into Postmasters? The Electric Telegraph as an Instrument of Command in the Prussian Army," *Military Affairs* Vol. 37, no. 2 (April 1973), 49.

[30] Carl Von Clausewitz, *On War*, ed. and trans. Michael Howard & Peter Paret (Princeton, NJ: Princeton University Press, 1976), 87.

[31] Daniel J. Hughes, *Moltke on the Art of War* (Novato, CA: Presidio Press, 1993), 36

> In this uncertainty, strategy must always direct its endeavors toward the highest aim attainable with available means. Strategy thus works best for the goals of policy, but in its actions is fully independent of policy.[32]

One of Moltke's greatest fears was that technologies such as the telegraph would enhance the capability of political leaders to interfere in the conduct of operations by requests for information and advice, or even criticisms, without a full appreciation for the actual circumstances at the front.[33] Fortunately for Moltke, field mobile telegraphs were very unreliable, and required a fixed station from which to broadcast and receive. As a result, communications between the railheads from which troops deployed and the front were still conducted mostly by messengers. Telegraph communications primarily carried traffic between General Headquarters and the capital. Moltke's own understanding of the difficulties commanders in the rear had in comprehending fully the complexities of unfolding events at the front led him to advocate a decentralized approach to operations that is today commonly called *Auftragstaktik*. This term has come to mean the doctrine of ensuring that lower levels of command, once given broad operational goals, have ample initiative to adapt to evolving battlefield conditions and are empowered sufficiently to make independent decisions, especially if communications with higher echelons are lost. The 1888 German Drill Regulation of the Infantry stated that commanders give subordinates general orders on *what* is to be done, leaving them wide latitude to decide *how* to do it.[34]

Auftragstaktik came about as the result of a convergence of various factors. After Napoleon's *levée en masse* allowed him to field armies of enormous size to overwhelm his opponents, all the great powers instituted programs of conscription to enlarge their armies. Improved firepower, from both rifles and artillery, greatly increased infantry casualties and led these larger armies to disperse for protection. This decreased the number of troops a single person could effectively command (In the Prussian system this devolved to the company level.)[35] Increased mobility by rail also increased the range

---

[32] Ibid., 44-45.

[33] Dennis Showalter, "Soldiers into Postmasters," 49.

[34] John T. Nelsen II, "*Auftragstaktik*: A Case for Decentralized Battle," *Parameters*, Vol. 17, September 1987, 22.

[35] Van Creveld, *Command in War,* 146.

over which armies could operate in a single day, and so added to the uncertainty higher echelons had of unit locations until they could communicate back to headquarters. Moltke realized that these larger forces and rapidly changing circumstances on the battlefield exerted serious limitations on the capabilities of higher-level commanders to control the myriad of details inherent in combat. *Auftragstaktik* offered a solution whereby higher echelons gave orders in sufficient detail for subordinates to understand the overall intent of the higher echelons and under which they could act independently, exploiting fleeting opportunities in battle without requiring further guidance and orders from above.

Communications technology, in the form of telegraphs, and later wireless radios, would soon develop to the degree where front line units could easily be in contact with higher headquarters. In World War I command and control of operations from the rear would reach opposite extremes for the major combatants along the western front.

Command From the Rear

By 1914, the success of the German Forces in the war of 1870 had become as thoroughly analyzed by all great militaries as Desert Storm has been for contemporary readers. Rail transport of troops to the front, a large general staff that coordinated the overall strategy and operations, and a growing web of communications that, with the invention of wireless transmitters, allowed direct contact with front line units, led to ever increasing centralized direction of all aspects of combat. The conduct of war soon became an exercise in scientific management principles, with those in the rear exerting ever more direction over minor tactical situations. As J.F.C. Fuller noted:

> In the World War nothing was more dreadful than to witness a chain of men starting with a battalion commander and ending with an army commander sitting in telephone boxes, improvised or actual, talking, talking, talking, in place of leading, leading, leading.[36]

Increased communications capabilities had convinced staffs and leaders that an adequate picture of battlefield conditions could easily be transmitted back to a rear

---

[36] J.F.C. Fuller, *Generalship: Its Diseases and Their Cure* (Harrisburg, PA: Military Services Publishing Co. 1936), 61.

headquarters from which a detached view, a larger perspective of battlefield conditions, could be pieced together and decisions made and transmitted back to the front. Front line units, with the best possible information on actual local conditions, remained tied to rear headquarters for guidance and direction. British operations during the Battle of the Somme are replete with examples of regiments given a specific order, timed to coincide with an artillery barrage, to advance on German positions toward an objective. Battalion commanders stayed behind in the trenches as their troops advanced in order to maintain communications with rear headquarters. Fragile field communications easily broke down as the troops advanced; battalion commanders effectively lost awareness of their troops' situation and so could communicate little information back to higher echelons. The troops themselves had received very specific instructions on their objective. Once they attained it, would passively await further orders, often letting great opportunities for further exploitation slip away.[37]

German armies were little different during the first years of the war, depending as much as their adversaries for communications with headquarters for guidance. Yet a critical difference as van Creveld points out was that the Germans viewed confusion, the fog of war, as a normal part of battle, and had compensated for it by their doctrines of decentralization and pushing decision making responsibilities to lower levels.[38] By 1918 German units had organized highly independent "storm trooper" units capable of offensive action with little guidance or control from the rear. Higher headquarters assumed from the start that communications would break down and planned accordingly. Units received broad objectives and were allowed to exploit fleeting opportunities while still accomplishing the overall mission.[39]

If technically each of the combatants in the First World War possessed equivalent capabilities, it was in their employment that the Germans differed from the Allies. The decentralized operations of the storm trooper units compensated for the inevitable breakdown of communications at the front. Rigid adherence to a top-down directed

---

[37] For detailed discussion see van Creveld, *Command in War,* 160-66.

[38] Ibid., 169

[39] Ibid., 168-84. See also, Timothy T. Lupfer, *The Dynamics of Doctrine: The Change in German Tactical Doctrine During the First World War* (Fort Leavenworth, KS, Combat Studies Institute, July 1981), 37-54.

system of command led to huge allied casualties for little gain. It is worth noting, however, that for all of its tactical successes, the decentralized storm trooper offensive led to only fleeting gains. Unable to sustain a larger offensive, German lines collapsed under the weight of the advancing allies only five months after the first gains by the storm troopers. Successful tactical doctrine would not compensate for strategic errors.

USAAF Operations in World War II

The 20-year hiatus between the two world wars led to revolutionary changes in the conduct of war. The static trench warfare of WWI had appalled contemporaries and driven a quest to increase the capabilities of forces to conduct mobile, armed warfare to preclude such a stalemate from ever recurring. Armored tank warfare was one such avenue advocated by J.F.C. Fuller, B.H. Liddell Hart, George Patton, and Heinz Guderian. Airpower was another path that adherents such as Giulio Douhet, William Mitchell, and Hugh Trenchard advocated for avoiding the carnage of the trenches. By 1940 The United States and Great Britain had developed offensive air forces based on beliefs in the efficacy of bombing enemys' industrial centers of gravity to destroy their warfighting potential.

Perhaps the most revolutionary new technology to assist in the employment of air forces was radar. First discovered in 1922 through an accidental observation of a ship's passage along the Anacostia River in the United States, the ability of high frequency radio waves to measure distances to ships and aircraft became a closely guarded secret.[40] In 1935, Sir Robert Watson-Watt of Great Britain wrote a detailed memorandum to the Committee for the Scientific Survey of Air Defense advocating a series of radar sites that could provide an "invisible curtain" around the likely approach routes of enemy aircraft. By September 1939, the British had over 57 radar stations along their eastern and southern coasts providing a continuous watch of the air.[41] Within the year this "Chain

[40] Robert M. Page, *The Origins of Radar* (Garden City, NJ: Doubleday and Company, Inc., 1962), 15-26.

[41] Robert Watson-Watt, *The Pulse of Radar* (New York: The Dial Press, 1959), 55-59, 115. See also Alan Beyerchen, "From Radio to Radar" in *Military Innovation in the Interwar Period."* Ed. Williamson Murray and Allan R. Millet (Cambridge, UK: Cambridge University Press, 1996), 275-87.

Home" system of radar sites formed the backbone for the air defense of Great Britain. By detecting German aircraft at ranges of several miles, British aircraft could fly out and mass against the inbound targets, rather than dispersing into larger formations that would have to provide defense over a much larger area.

While greatly increasing the efficiency of limited fighter assets, the air defense system inevitably led to a centralization of control at the sector, group, and Fighter Command Headquarters. Initial reaction to this command from the rear almost led to the system's demise. The British Minister of aircraft production, Lord Beaverbrook had heard complaints from RAF pilots that ground controllers were, "cramping the cherished initiative and freedom of action of the fighter pilot."[42] He called Sir Watson-Watt in and urged him to cease development of radar. Watson-Watt warned him not to rely on anecdotal evidence and prevailed in his determination to produce more radar suites.

Although initially designed as a static defensive measure, radar soon evolved to provide mobile support for advancing forces. During the North Africa campaign, mobile radar units were in short supply. Part of the reason the allies lacked air superiority was the inability to move radar units of the XII Air Support Command to the front. General Carl Spaatz, Commander of the North African Air Forces (NAAF) and later of 12th Air Force as well, recognized in the spring of 1943 the need to push radar units as close to the front as possible in order to detect Luftwaffe aircraft at as great a range as possible.[43] To organize these various radar units into a cohesive whole, Spaatz consolidated the radar and reporting units into Tactical Control Groups (TCG). These units provided overall early warning of inbound hostile aircraft and provided friendly air units with control during the engagements.

A number of units contributed to the success of this early Tactical Air Control System (TACS). The TCG assigned sectors to Tactical Control Squadron (TCS), normally four squadrons to a group, and split their responsibilities geographically. Each TCS had responsibility for supporting a number of airfields in its area as well as the radio capability to communicate with aircraft in its sector. The TCG would designate one

---

[42] Watson-Watt, *The Pulse of Radar*,180.

[43] Richard G. Davis, *Carl A. Spaatz and the Air War in Europe* (Washington D.C: US Government Printing Office, 1993), 171, 186-87.

squadron as the lead element, and it would assume duties as the Tactical Control Center (TCC). The TCC functioned similar to today's Air Operations Center in controlling the various early warning, fighter control, forward director post, microwave early warning units, and battle area control units; in providing targeting information; threat warning (both hostile air units and known enemy flak locations); as well as home base weather

information for early return to base orders.[44]. As in the British system of Fighter Command for air defense, sector controllers maintained control over the aircraft in their area until the fighters engaged visually, when flight leads would take over.

Among the elements engaged, command and control issues also surfaced for offensive air missions. The Battle Area Control Units (BACU) were the most interesting. They provided control for the "blind bombing" missions. These units used the SCR-584 Automatic Tracking Fire Control Radar to provide accurate positioning information to bombers tasked in poor visibility. Used sporadically in North Africa, they were especially useful in the European theater. General Pete Quesada's IX Tactical Air Command enjoyed enormous successes by August of 1944 in using a BACU to direct blind bombing missions to their targets. Aircraft would radio back airspeed, winds, and altitude, to a controller who would enter the information into a Norden computer on the ground. As the SCR-584 locked onto and tracked the aircraft's position on a map, it would radio a message to the aircraft to release its bombs.[45] The pilot had merely taken directions from the ground. This same capability gave Quesada the ability to re-direct aircraft in flight from one target to another even after they had taken off for their pre-planned targets, a capability that would give air commanders much greater flexibility in the future. The ability of rear area headquarters to control airpower operations had begun.

Command. Control, and Uncertainty

Martin van Creveld postulates that the essence of command and control systems is the ability to feed desired information to the appropriate command level.[46] Commanders naturally seek certainty in their quest for information. Given enough time, uncertainty can be reduced. The struggle during war is to balance the need for certainty against the

[44] Thomas H. Buchanan, *The Tactical Air Control System: Its Evolution and its Need for Air Battle Managers*, College for Aerospace Doctrine, Research, and Education (CADRE) (Maxwell AFB, AL: Air University Press, 1987), 7-9.
[45] Thomas A. Hughes, *Overlord: General Pete Quesada and the Triumph of Tactical Air Power in World War II* (New York: The Free Press, 1995), 186-188.
[46] Van Creveld, *Command in War,* 265.

time required to make a decision.[47] Van Creveld further argues that uncertainty is a given in war, and the decision commanders need to make about their command and control structure concerns the distribution of uncertainty. If uncertainty can be tolerated at the top, while simultaneously reduced at lower levels, effective decentralized execution can take place. This was the essence of *Auftragstaktik* for Moltke, as well as the successful operations of the storm troopers in 1918. Conversely, if higher command elements seek increasing levels of certainty (e.g. confirmation of positions of friendly and enemy units, intent of enemy, weather, terrain, etc.), then valuable time is used up; and lower levels, by waiting for an appropriate decision to act from the top, will be left to shoulder the uncertainty.

John Schmitt also believes that historically there have been two methods of dealing with uncertainty. The first is to pursue certainty in designing a command and control system, the second to accept uncertainty and design around it.[48] By demanding more certainty, the C2 system becomes technology-intensive, requiring a great deal of computing power to process all of the available information. This also leads to a highly centralized and inflexible system, minimizing subordinate decision-making. In striving to overcome uncertainty, it seeks to overcome one fundamental aspect of war itself, fog.[49] If uncertainty is accepted by the C2 system as a given, i.e., if the need for certainty is minimized, then decision making is pushed to lower levels by default when the commander gives broad guidance.

The C2 system thus appears to be more than just the technology associated with transmitting information, but a philosophical approach, a conscious decision, on what the limitations of war are and how, or whether, they can be overcome. Technologies can provide for sensor-type information (imagery, radars, signals); processing capabilities through the use of computers to sift and sort through the sensor information collected; decision aides through the use of computers to spot trends, or correlate disparate pieces of

---

47 Frank M Snyder, *Command and Control: The Literature and Commentaries* (Washington DC: National Defense University Press, 1993), 15.

48 John F. Schmitt, "A Concept for Marine Corps Command and Control," in *Science of Command and Control Part III: Coping with Change* (Fairfax, VA: AFCEA International Press, 1994), 17.

49 Ibid.

information; and communications to link commanders with subordinates to transmit information and decisions. [50] Commanders, however, choose how to process, decide, and disseminate the information that the technology provides.

One of the problems with processing information at a rear headquarters is that assimilating the information into a coherent picture of the unfolding situation is at best only a facsimile of reality. Confusing these representative displays with actual events, even if the data appears correlated in time as actual events unfold, can mislead. The information sent to the rear will have been filtered at various levels based on reporting thresholds and criteria, each one introducing a bias that can skew the presentation. Even Clausewitz noted of reports sent back to headquarters that "This difficulty of accurate recognition constitutes one of the most serious sources of friction in war, by making things appear entirely different from what one had expected."[51] The product of these displays is the result of the actions of the many individuals in the whole system. Each individual makes a decision on what is or is not important in summarizing the sensed event and relaying it back. This can take the form of a report, written or verbal, or even of pre-defining a computer algorithm threshold below which one will discard certain information. Algorithms themselves are only as accurate as the information used to calculate them. Each of these smaller, individual acts accrues errors and places a finite limit on certainty.

A C2 system can be viewed as the product of many different wills, ideally each one acting in support of the will of the commander. Frequently, critical information is available somewhere within the C2 system; however it is not able to reach the correct person either because the request for information did not reach the holder of that information in time (e.g., imagery dissemination problems from national sources to the theater during Desert Storm) or the holders may not have realized that they possessed important information (e.g., radar operators in Hawaii watching inbound Japanese aircraft on 7 December 1941). If a C2 system is designed to place a premium on certainty, each individual within that system will also seek certainty before acting. As van Creveld and

---

[50] Thomas P. Coakley, *Command and Control for war and Peace* (Washington DC: National Defense University Press, 1992), 56.

[51] Clausewitz, *On* War, 117.

Schmitt note, this will drive operations toward a hierarchical and centralized system that leaves lower echelons waiting for orders to act, unable to exercise initiative. The following chapters trace the development of Air Force C2 systems to test how far technological advances in sensors and communication drive air operations toward centralized execution.

Chapter 3

COMMAND AND CONTROL DURING LINEBACKER II

The command-and-control structure in Southeast Asia (SEA) was the largest such system established for air operations since the end of the Korean War. By 1972, five Tactical Air Control Centers (TACC) controlled air operations in North and South Vietnam as well as Laos and Cambodia. The structure evolved slowly over the years in response to mission changes, but accelerated in 1965 in response to force build-ups. As a result, redundant elements appeared; and overlapping areas of responsibility were frequent. Additionally, the quest for unity of command over air assets eluded the efforts of all components during the conflict and added to the command-and-control complexity. The services strove to maintain operational control of their assigned air assets and created extensive intermediary organizations, complicating the chain of command by creating significantly different structures.

This chapter will summarize the evolution of the Southeast Asia command organization up to 1972, then describe the structure of the command-and-control systems in place at the end of that year, and finally analyze the conduct Operation Linebacker II in order to assess the extent of decentralized execution of air operations in light of the technologies available to the TACCs in charge.

History of Command Organization (1962-1966)

The Commander in Chief, Pacific Forces (CINCPAC) had overall responsibility for conducting the war in Southeast Asia. In February 1962 CINCPAC authorized the establishment of Military Assistance Command, Vietnam (MACV), placing it in charge of all US forces in Vietnam. MACV was a sub-unified command reporting directly to Pacific Command (PACOM). Five months later CINCPAC also established Military Assistance Command, Thailand (MACTHAI) and made the commander of MACV its commander as well. Although staffed primarily by army officers, MACV had joint service representation through component commanders on its staff.

Until 1966, the Commander, 2^{nd} Air Division (AD), headquartered in Saigon with MACV, acted as the air component commander for MACV, with operational control of Air Force assets within South Vietnam. 2^{nd} AD also exercised operational control over Air Force assets in Thailand that at the time were assigned to 13^{th} Air Force (AF) based at Clark AFB in the Philippines. 13^{th} AF reported to Pacific Air Command (PACAF). In July 1965, under pressure from the Thai government, which resented the administration of military affairs in its country from a headquarters in Saigon, PACOM split the duties of MACV and MACTHAI into two separate commands, each with separate commanders. Also in 1965, PACAF made the 2^{nd} AD a direct reporting unit and gave it operational control (OPCON) of 13^{th} AF air assets in Thailand. In effect, 2^{nd} AD had two chains of command: it reported to MACV for air operations in South Vietnam and to PACAF for air operations outside of South Vietnam.[52]

By 1966 the US buildup of Air Force assets in SEA had grown too large for the operational and administrative staff of a single air division. On 28 March 1966, PACAF deactivated the 2^{nd} AD and in its place activated 7^{th} AF as the Air Force Component Commander to MACV at Tan Son Nhut Air Base in South Vietnam. 7^{th} Air Force's areas of responsibility (AOR), however, exceeded the confines of South Vietnam, the AOR for MACV. 13^{th} Air Force still maintained administrative control of Air Force assets in Thailand, but 7^{th} AF had OPCON of the air assets under the same arrangement as had 2^{nd} AD. Air operations within South Vietnam were designated as "in-country" while those external to South Vietnam were called "out-country." Further complicating the command arrangements was the dual designation of the 7^{th} & 13^{th} AF deputies. A single individual was the deputy for both numbered air forces. However, while 7^{th} operated out of South Vietnam and 13^{th} from the Philippines, the deputy maintained his staff in Thailand, mostly to ease coordination with the Thai government, but also to keep the US ambassador there briefed on air operations flown from Thailand. As the senior US representative, the ambassador had approval authority over the use of force from

[52] John J. Lane Jr., *Command and Control and Communications Structures in Southeast Asia* (Maxwell AFB, AL: Airpower Research Institute, 1981), 39-46.

Thailand.[53] To clarify matters, this organization was designated 7th/13th AF.

As the overall theater commander, CINCPAC had to consider many possible contingencies in his war planning. Aside from the war in Vietnam, the danger of Chinese intervention, an event well within the working memories of senior leaders who fought in Korea, was a threat that had to be anticipated. Many of the command arrangements by 1965 were put in place to give CINCPAC the operational flexibility to concentrate his forces if events in Vietnam led to an escalation of the conflict.[54] In addition to the Air Force assets in South Vietnam and Thailand, the US Navy flew missions against North Vietnam from the Gulf of Tonkin. Task Force 77 (TF 77) was a subordinate organization under 7th Fleet. Seventh Fleet reported to Commander in Chief, Pacific Fleet (CINCPACFLEET), the Naval Component Commander of PACOM. Task Force 77 directly managed the bombing of targets in North Vietnam and, by Linebacker II, consisted of 6 Aircraft carriers.[55] CINCPAC, Admiral U.S. Grant Sharp in 1965, had created a highly centralized command structure for the air war in Vietnam, responsive to his needs as the theater commander, which changed little for the duration of the war.

This may have been a response to the perceived political dangers if the war in Vietnam escalated to the point of a confrontation with either China or the Soviet Union. During his term in office, President Johnson was extremely wary of letting military events in Vietnam cause an intervention by China, much as they had in Korea. As a senator in 1950, Johnson had strongly supported Truman's decision to relieve General Douglas MacArthur, who had underestimated China's willingness to intervene.[56] President Johnson's Tuesday lunch meetings, at which he and key advisors met to discuss and make decisions on a variety of national policy issues, would very often devolve into picking individual targets. Johnson and his staff hoped to send specific messages to the Hanoi regime via the targeting strategy, but they also strove to ensure the Chinese and

---

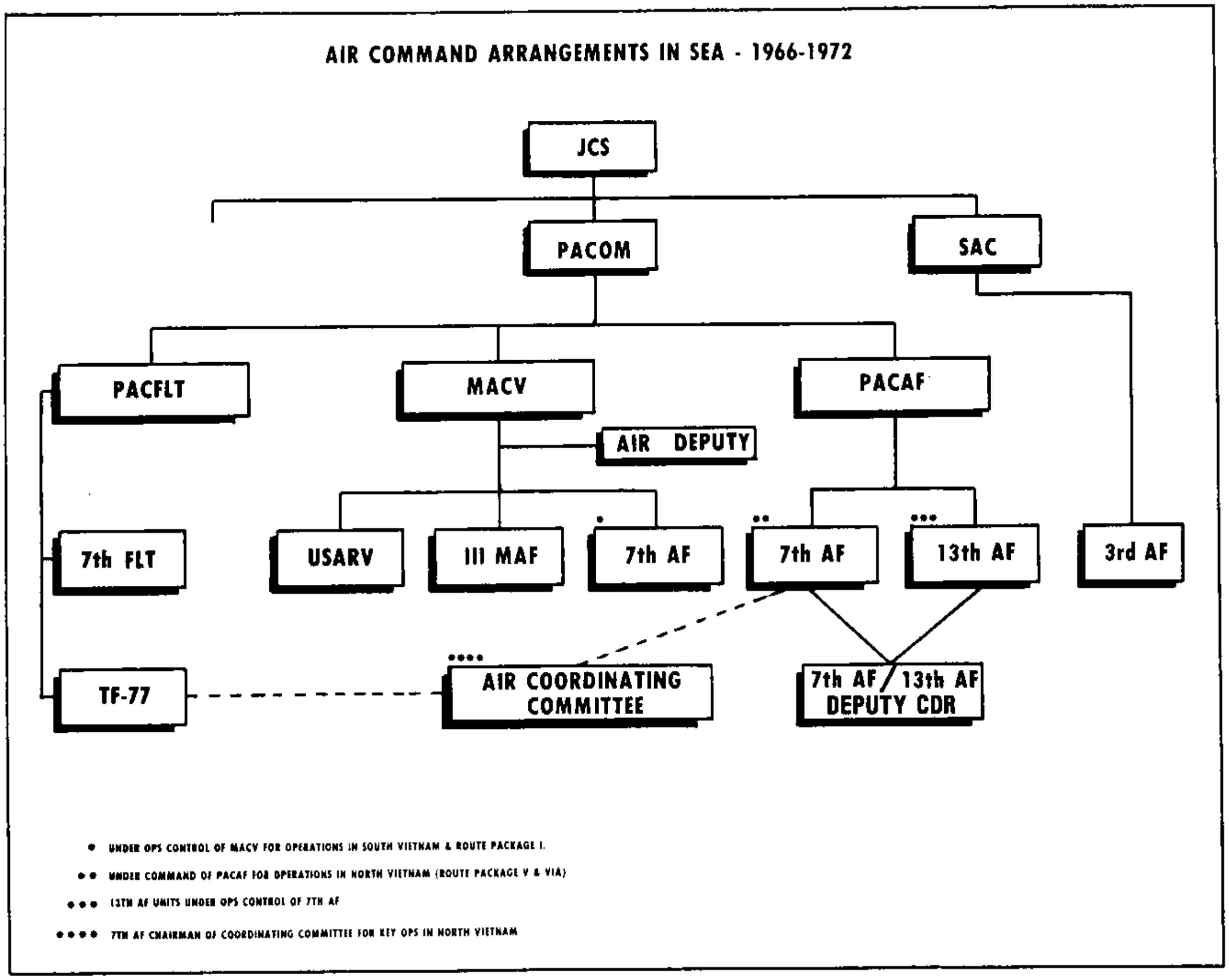
[53] William W. Momyer, *Air Power in Three Wars* (Washington DC: United States Government Printing Office, 1978), 82-84.
[54] Ibid., 78.
[55] Mark Clodfelter, *The Limits of Airpower* (New York: The Free Press, 1989), 161.
[56] Wayne Thompson, *To Hanoi and Back: The U.S. Air Force and North Vietnam, 1966-1973* (Washington D.C.: Smithsonian Institution Press, 2000), 19.

Russians would not interpret the strikes as escalatory.[57] As the National Command Authorities approved targets for attack, they sent these lists directly to CINCPAC. If the targets were in South Vietnam, CINCPAC would task MACV who would then pass them on to 7th AF for an in-country mission. If the targets were in North Vietnam or Laos, CINCPAC would assign them to his respective Air Force or Navy component commanders. PACAF would then transmit the information to 7th Air Force for an out-country mission, while CINCPACFLEET would send them to 7th Fleet which would forward them to TF-77. (Figure 1)

---

[57] For excellent discussion see David C. Humphrey, "Tuesday Lunch at the Johnson White House: A Preliminary Assessment," *Diplomatic History* 8 (Winter 1984): 81-101. Also Wallace J. Thiess, *When Governments Collide: Coercion and Diplomacy in the Vietnam Conflict, 1964-1968* (Berkeley, CA: University of California Press: 1980), 71-75.

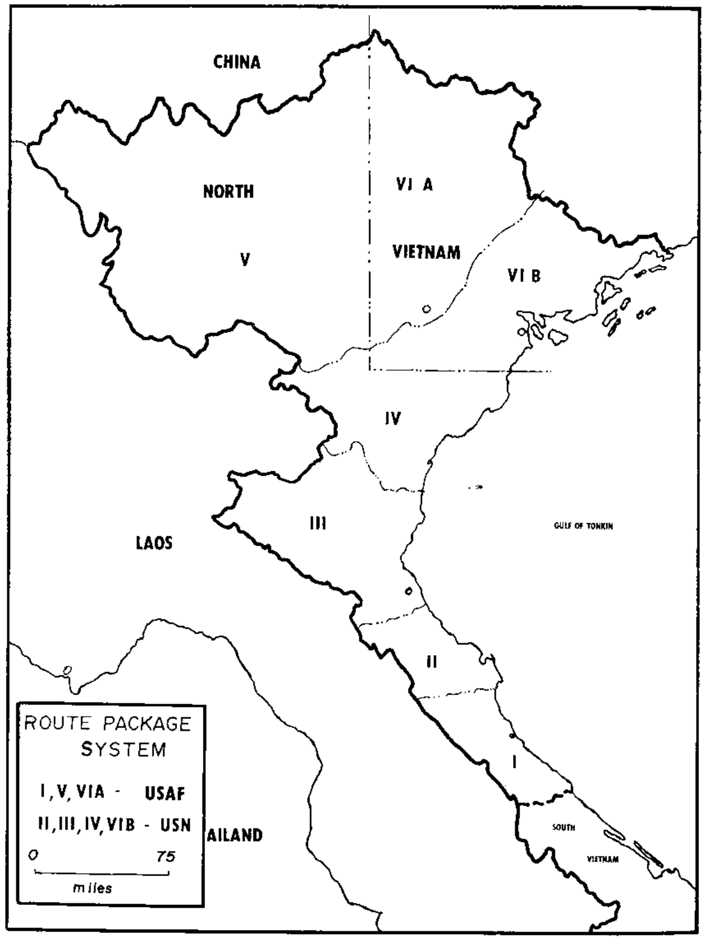
Figure 1. Command-and-Control Organization for Air Operations in SEA (from Momyer)



For operational air commanders, both the Air Force and Navy, eliminating conflicts among aircraft and coordination of support assets, such as surface to air missile suppression, early warning, and electronic counter-measures flights, required coordinated control measures. Lacking a consensus on the creation of a single air manager for the theater, the best arrangements, in the sense of a least amount of pain for all concerned, was to separate the bombing areas geographically. In 1965, air planners divided North Vietnam into seven “route packages” (designated RP 1-5, 6A, & 6B). These route packages were effectively zones of exclusive operations for the services assigned the area. The Navy had four route packages and the Air Force three (figure 2). Operations by one service in the route package of another were infrequent and required detailed

coordination.[58] In 1965, another organizational command problem arose when B-52s joined the war effort.

Figure 2. Route Packages (from Momyer)



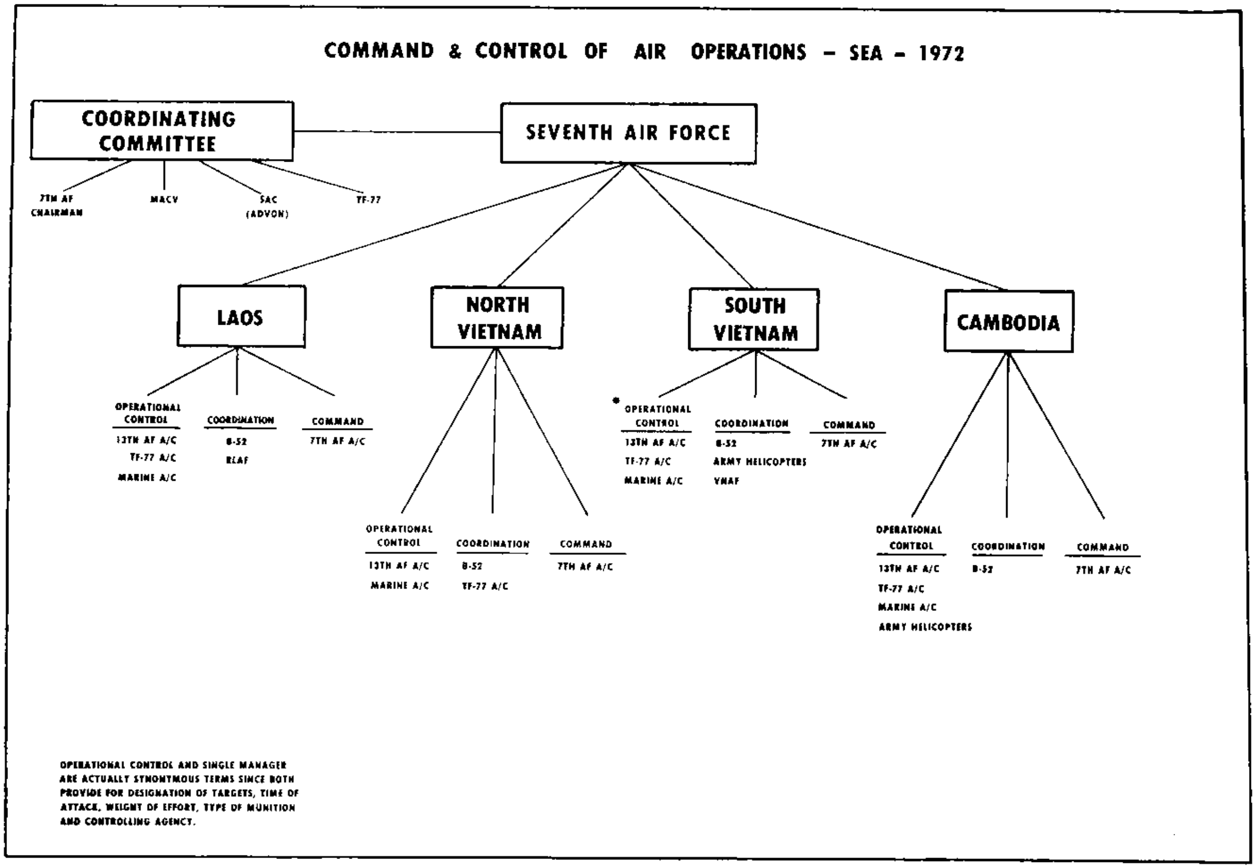
Tasked to fly missions throughout the theater, the B-52s created a dilemma. The problem centered on the need to maintain a credible nuclear response in the event of general war with the Soviet Union, a capability that required the B-52s in Southeast Asia to be placed under the control of Strategic Air Command (SAC), whose headquarters was located at Offutt AFB, Nebraska. In preparing for conditions of general war under the Single Integrated Operational Plan (SIOP), the requirement for a streamlined chain of command for nuclear-capable forces precluded assigning the B-52s to either the theater commander, CINCPAC, the sub-unified commander, MACV, or the functional component commander, 7th AF. As a result, SAC gave operational control of the B-52

[58] Clodfelter, *The Limits of Airpower* ,130.

missions (as well as SAC tanker aircraft) to the 3^{rd} Air Division, later changed to 8^{th} AF in 1970, at Anderson AFB, Guam. To assist in operational planning, SAC created an advanced echelon (ADVON) team of B-52 and tanker experts and attached it to MACV under the Deputy for Air Operations, rather than directly to 7^{th} AF. The commander of 7^{th} AF was dual-hatted. As 7^{th} AF Commander, he was the service component commander for MACV; but as a functional component commander, he was also the MACV Deputy for Air Operations. Lieutenant General William Momyer, Commander, 7^{th} AF, sought to gain operational control of the SAC bombers; however, even senior Air Force leaders, to include Commander in Chief, SAC (CINCSAC) and the Air Force Chief of Staff, would not approve delegating OPCON of the B-52s to 7^{th} AF.[59] Instead, the SAC ADVON element reported to 8^{th} AF and coordinated its efforts through the 7^{th} AF commander in his role as MACV Deputy for Air. With little change for the remainder of the war, the arrangements for the control of airpower during Linebacker II in 1972 were those solidified in 1966. (Figure 3)

[59] Momyer, *Air Power in Three Wars* ,99-104.

Figure 3. Command and OPCON of Air Operations, 1972 (from Momyer)



In summary, the command organization for operations in Southeast Asia was convoluted and territorial in nature. A rigidly hierarchical organization led to centralized control of airpower from outside the area of operations to rear headquarters as far away as Honolulu and Omaha. This thesis will not address the merits of the targeting strategy involved in SEA; however, it is worth noting that the specific targets picked went through an equally complicated approval process including each of the organizations listed above and ultimately depended on final approval from the NCA. When the component commanders finally received their targets, the execution of those missions required a functioning Tactical Air Control System (TACS) to provide the requisite command and control capability.

Command-and-Control Structure: Tactical Air Control Centers

Doctrine for Tactical Air Force Operations from 1967 - 1973 designated the Tactical Air Control Center (TACC) as the senior element of the Tactical Air Control System (TACS).[60] As such, it functioned as the facility through which the air component commander exercised centralized control over air assets. The 7th AF TACC was located at Tan Son Nhut airbase near Saigon. According to the Saigon Sub-Sector guide, "the TACS provides the Commander 7th Air Force with the organization and equipment necessary to plan, direct and control tactical air operations and to coordinate air operations with other components and services."[61] In fact, by 1967 the TACS system in Southeast Asia consisted of five TACCs located throughout Vietnam and Thailand.

Within the 7th AF TACC, four directorates ran different aspects of the air war. The Director, TACC, had primary responsibility for the daily in-country strikes and air defense of South Vietnam. He exercised daily OPCON of the in-country missions through a subordinate system of control centers detailed below.[62] The majority of the in-country missions were for Close Air Support (CAS) of ground forces, both preplanned and immediate. The TACC planned, controlled, and directed all Vietnamese, USAF, Marine, and Free World Military Assistance Forces (FWMAF, allied nations assisting the US) tactical air operations in South Vietnam.[63] Two additional directorates under the 7th AF TACC were the Airlift Control Center (ALCC) in charge of airland operations, resupply, aeromedical evacuation, and defoliage missions; and the Joint Search and Rescue Center (JSARC).[64]

Because the 7th AF TACC's AOR covered MACV's primary operating area, it was the natural focal point for liaison elements from the other services. Marine and Navy

---

[60] Air Force Manual (AFM) 2-7, *Tactical Air Force Operations: Tactical Air Control Systems (TACS)*, 5 Jun 1967, 9.

[61] 619th Tactical Control Squadron, *TACS: Saigon Sub Sector*, (Air University M-U 42589-2: Project Corona Harvest), 1-1. (Hereafter *TACS-Saigon*)

[62] *Seventh Air Force Tactical Air Control Center Operations* (Air University Library M-U 38245-74: Project CHECO Southeast Asia Report, 15 October 1968), 36-37. (Hereafter *7th TACC*)

[63] *TACS Saigon, 1-4*

[64] Ibid.

officers provided coordination and mission details to the 7th AF TACC staff; and an army unit, the Tactical Air Support Element (TASE), provided officers to assist with CAS requests. Additionally, Vietnamese Air Force (VNAF) officers worked closely with the American Staff. Officially, a VNAF colonel was the TACC director while a USAF Brigadier General was the deputy. Operationally, the VNAF staff controlled VNAF assets, while the USAF staff controlled US and FWMAF operations. [65]

The fourth directorate under the 7th AF TACC was a US-only facility staffed by the Directorate of Combat Operations (DCO). This facility, called the 7th AF Command Center (7AFCC), actually functioned as a separate TACC and exercised control over the out-country strike missions, as well as the in and out-country reconnaissance and electronic warfare missions. The 7AFCC also exercised operational control over the out-country TACS elements.[66] Separate service liaison elements were required due to the geographical separation of the areas of responsibility; 7th AF TACC was responsible for in-country ops, while 7AFCC was responsible for out-country ops.

The third TACC in the Southeast Asia TACS was the 7/13AF TACC located at Udorn, Thailand. The 7/13 AF TACC was an alternate command center for the 7AFCC and had radar coverage extending over Laos and into parts of North Vietnam, as well as a robust communications capability with aircraft throughout the theater. If 7AFCC was not able to exercise command and control during a mission, 7/13 AF TACC would direct the execution until 7AFCC resumed operations.[67]

A fourth TACC was located on top of Monkey Mountain near Da Nang, South Vietnam. Designated TACC North Sector (TACC-NS), this facility provided control and coordination of air missions into North Vietnam and over the Gulf of Tonkin. Its specific mission was to monitor North Vietnamese airspace, preventing inadvertent overflight by US aircraft as well as early warning information of hostile aircraft to the 7th AFCC and

---

[65] *7th TACC*, 39.

[66] See Lane, *Command and Control and Communications Structures in Southeast Asia*, 76 and *7th TACC*, 36.

[67] *Command and Control of Southeast Asia Air Operations: 1 Jan 1965-31 March 1968 Book 4 (parts VI-VII)* (AFHRA TS-HOA-73-47: Project Corona Harvest) VI-1-8. (Hereafter *C2 in SEA*).

any airborne aircraft.[68]

The fifth TACC was also located at Udorn, Thailand. This facility was the designated backup for the TACC-NS and was appropriately named the Alternate Tactical Air Control Center - North Sector (ATACC-NS). It had functions similar to those of the TACC-NS in monitoring North Vietnamese airspace and relaying threat information, as well as deconflicting flights by friendly aircraft. Both TACC-NS and ATACC-NS were subordinate to 7AFCC.

Doctrinally, the TACC was the senior element of the TACS for a theater. It was ideally located in close proximity to the Air Force Component Commander (AFCC); operational necessity required an alternate or forward TACC in case operations at the primary became disrupted.[69] The TACC's primary written product was the daily Fragmentary Order (Frag) that stipulated all of the flying activity for the air assets tasked to perform missions the following day.[70] The 7th AF TACC was the primary TACC for operations in South Vietnam, while the 7AFCC was the primary TACC for operations in Laos and North Vietnam. The 7AFCC had three subordinate TACCs; the 7/13 AF TACC in Udorn, Thailand, was the primary alternate facility for out-country operations; the TACC-NS at Da Nang and its alternate, the ATACC-NS at Udorn, were forward TACCs charged with monitoring mission execution.

Command-and-Control Structure: Control and Reporting Centers/Control and Reporting Posts

As the senior command-and-control element, TACCs did not normally have radar assets assigned to them. Their primary function was to plan, control, and coordinate the employment of tactical air power.[71] The TACC received information on the progress of the day's flying activities via inputs from forward radar elements. The units immediately subordinate to the TACC were called Control and Reporting Centers (CRC). These units

[68] Briefing Transcripts on *TACS/TACC Operations* 31 Jan 1969 (AFHRA K740.153-3 Project Corona Harvest 31 Jan 1969), 10-11. (Hereafter *TACS Brief)* and *CORONA HARVEST C2 in SEA* VI-1-8, VI-1-16.

[69] AFM 2-7, 9.

[70] Ibid., 11.

[71] Ibid., 9.

had an assigned sector in which they were responsible for all air defense and airspace control missions. Control and Reporting Posts (CRP) were subordinate to the CRCs. CRPs were spread out geographically within the CRC's assigned sector and had responsibility for sub-sectors to fill in any gaps in radar coverage. Technically, the CRCs and CRPs had identical equipment configurations (radars, radios, computers, etc.). Their differences were purely functional; and, as such, any one CRP could assume a CRC function if a CRC were unable to fulfill its mission. Any further gaps in radar coverage would be filled via mobile Forward Air Control Posts (FACP). These were small, highly mobile radar units that could deploy rapidly to provide radar coverage along any gaps that might occur if a CRC or CRP were to fail, or if mountainous areas required coverage of regions masked by terrain. Screening in the northern portion of the South Vietnamese-Laotian border was particularly difficult.[72]

Command-and-Control Structure: Airborne Elements

Additionally, an airborne radar element deployed to Thailand in 1965. The College Eye Task Force consisted of EC-121 aircraft, a converted Lockheed Constellation airframe, that provide an airborne warning and control (AWAC) function. These aircraft flew in orbits over northern Laos and in the Gulf of Tonkin providing on-scene control of missions in both Laos and North Vietnam. The College Eye aircraft were subordinate to the TACC-NS and the ATACC-NS, performing functions similar to the CRCs and CRPs. Information on friendly and hostile aircraft was transmitted primarily via voice messages to the TACC-NS as well as to friendly aircraft flying in North Vietnam. Efforts during late 1968 gave a rudimentary capability to automate this function, with computers sending the information directly to the TACC-NS via data link.

In 1967 Rivet Top aircraft, EC-121s configured to provide a passive electronic signals intelligence (SIGINT) capability, deployed to Thailand. These aircraft provided a limited command-and-control function, interfacing primarily with the TACC-NS. By providing information on activation of ground radar sites and intercepts of voice communications from enemy aircraft, Rivet Top assisted airborne fighters in intercepting

[72] *TACCS Brief*, 11.

hostile aircraft as well as avoiding surface-to-air missile (SAM) threats. They would simultaneously pass this information to the TACC-NS.

The Airborne Battlefield Command and Control Center (ABCCC) was a specially modified C-130 aircraft (EC-130) that acted as an airborne command element capable of performing in a limited capacity as an airborne extension of the 7AFCC. It received the daily frag from 7AFCC and functioned as a forward-based decision-making authority. It worked very closely with the other airborne elements and ground units and had the authority to scramble alert aircraft as well as to divert preplanned missions onto more lucrative targets if the situation merited.[73]

One of the most difficult problems in SEA, with units spread out over a large area, was the problem of communication. Ultra-High-Frequency (UHF) radios were the primary means of air-to-air communication. Very-High-Frequency (VHF) radios were the primary system for air-to-ground communication with army units, while UHF was used between airborne and ground TACS elements. Both UHF and VHF were line-of-sight systems and were very susceptible to interference from terrain and atmospherics. As a result, 7th AF identified the need for a radio relay aircraft (RRA). SAC owned specially modified KC-135 aircraft that could receive transmissions on a given frequency, amplify the signal, and re-transmit the information on the same or another frequency. This capability allowed both airborne TACS elements as well as the TACC-NS to maintain a rudimentary capability for constant communications with airborne forces flying in North Vietnam, though reliability proved to be poor.[74]

Command-and-Control Structure: Close Air Support

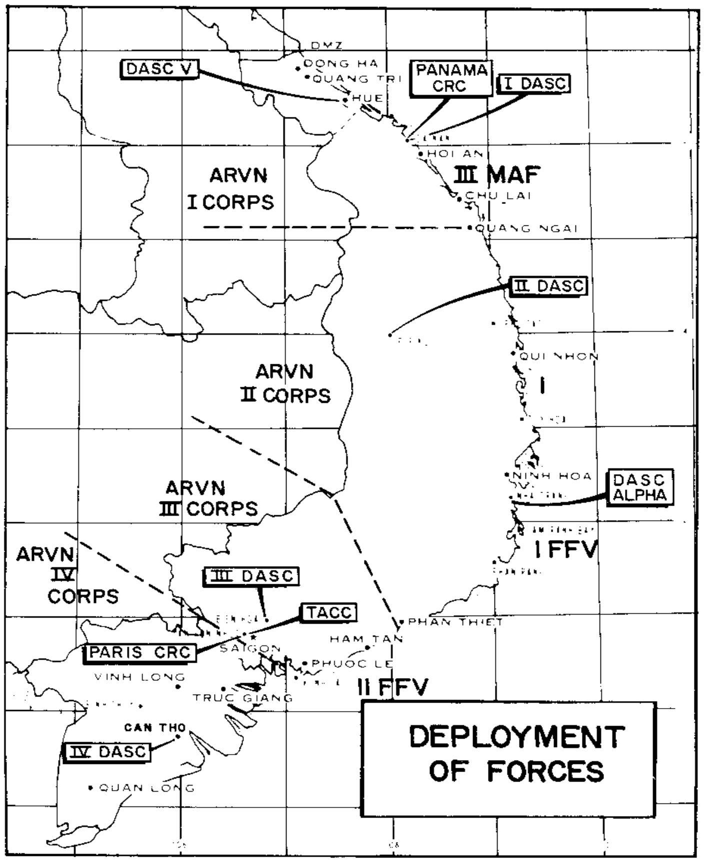
With the exception of the ABCCC, each of the command-and-control elements described above supported prosecution of the air defense and air superiority missions as well as strike missions into the Air Force route packages. However, in addition to its role in planning these missions, the TACC was also responsible for providing a responsive capability to MACV for CAS missions. 7th AF created an extensive liaison structure to facilitate the timely prosecution of CAS requests.

The Army of the Republic of South Vietnam (ARVN) had four corps with geographic areas of responsibility, called alternately Military Regions (MR) or Corps Tactical Zones (CTZ), divided along the lines shown in Figure 5. The US Army had two Field Force, Vietnam (FFV) units (they were corps equivalents, but this the term was used to avoid confusion with the ARVN corps in the same MR), the I FFV and II FFV in the central regions. The Third Marine Amphibious Force (III MAF) was in the far North. The TACC created a subordinate element in each of the four regions to facilitate the requests for preplanned and immediate CAS requests. The organizations immediately subordinate to the TACC and co-located with the Corps Tactical Operations Center (CTOC) were the Direct Air Support Centers (DASC). Doctrinally, they should have been called Air Support Operations Centers (ASOC); but in Vietnam the term DASC was adopted in 1965.[75] The DASCs provided an interface for matching the needs of ground commanders with available air assets and acted as extensions of the TACC's planning section. Air Liaison Officers (ALO) were USAF officers assigned to the DASC, which relayed requests to the TACC, which would in turn task a unit to provide a CAS mission in the daily frag. The DASCs were manned jointly by US and Vietnamese personnel, except for DASC Alpha, which was a US-only DASC responsive to the US Army I FFV.

---

[73] Lane, *Command and Control and Communications Structures in Southeast Asia,* 80.
[74] Ibid., 116.
[75] Ibid., 73.

Figure 4. Ground Forces in South Vietnam (from *7th TACC*)



In order to facilitate the receipt of information from lower echelons, Tactical Air Control Parties (TACP) were attached to units ranging from divisions to battalions. These were small teams of from three to six personnel consisting of an Air Liaison Officer, a Forward Air Controller (FAC), and a radio operator. The TACPs advised their respective command elements on the proper use of airpower for ground support and directed the employment of CAS aircraft in their AOR. Originally the FACs operated from the ground, usually on terrain that offered an unobstructed view of the battlefield. However, by 1964 the utility of airborne FACs had become clear. In that year, 76 USAF FACs were attached as advisors to the CTOCs, with more to follow over the years.[76] By 1969, 700 FACs were authorized for the theater.[77] FACs not only controlled air strikes; but one of their major functions was visual reconnaissance, providing enormous

---

[76] John J. Sbrega, "Southeast Asia" in *Close Air Support*, ed. Benjamin F. Cooling (Washington DC: US Government Printing Office, 1990), 434-35.

[77] *TACS Brief*, 17.

intelligence data along coastal and border areas.[78]

In 1968 MACV and 7th AF developed a new system of allocating CAS assets to the respective corps. Seventy percent of the available CAS missions were allocated via a weekly frag to the major ground commanders.[79] Lower echelon ground commanders received sub-allocations that allowed them to use air assets in any way they saw fit, under advisement of their respective ALOs. In essence, the weekly frag produced dedicated air support to the ground commanders, though the TACC could withdraw the support if the situation warranted. The remaining 30% of sorties were made available via request through the daily frag. Ground commanders would submit requests to their ALOs, who would filter requests and pass them up to the TACC. This simplified method allowed MACV and 7th AF to concentrate air requests in areas where they were most needed, without significantly disrupting the weekly planned flying schedule.[80] A number of sorties were not counted in the weekly totals that 7th AF held in reserve as strip-alert aircraft. These aircraft were available for any ground commander, through the TACS, for immediate CAS requests.

The Air Request Net (ARN) was the primary vehicle by which units requested immediate CAS missions. Any unit could make a CAS request on this primarily High Frequency (HF) radio net. Army Air Ground System (AAGS) was an organizational staff that processed, evaluated, and coordinated fire or reconnaissance requests from battalion to corps level. Because TACPs were collocated with AAGS personnel, coordination for filling immediate CAS requests was very easy. If an organic fire unit could not meet the request for strike support and if any higher-echelon commander did not deny the request, the DASC had the authority to fill the request by diverting an airborne mission or requesting a strip-alert aircraft to scramble. If a request was outside of the DASC's authority, for example, diverting aircraft from one corps' region to another (since each DASC had only a corps' area of responsibility), it would contact the TACC that could authorize the intercorps change and would also coordinate the change through the TASE.

---

78 Ibid., 18.

79 *7th TACC*, 15.

80 *History of Close Air Support Command & Control*, Tactical Air Command Directorate of Studies and Analysis, 1 May 1973. Air University Library M-U 41737-252, 81.

The final part of the CAS command-and-control structure involved Marine Corps Aviation. The III Marine Amphibious Force (MAF) had organic air assets that, according to Marine Corps doctrine and practice, supported the Marines on the ground and filled their CAS requests. Figure 5 shows that the III MAF fought in the northern portion of South Vietnam. By late 1967, however, enemy combatants in MR I, the ARVN I Corps area, began to tax the Marine's capability to provide sufficient

firepower.[81] The Tet Offensive in January 1968 struck hardest in the I Corps area and required reinforcements from Army units in the ARVN II Corps area. By April of 1968 the number of Army battalions in the I Corps area had grown to 31, and Marine battalions from 21 to 28.[82] With the siege of the Marine base at Khe Sanh, the requests for CAS missions grew enormously. Providing effective C2 for these assets was complicated by the existence of a separate Marine DASC equivalent, called the Tactical Air Direction Center (TADC). MR I effectively had two separate C2 structures for providing CAS, which led in a number of cases to duplicate air strikes being made in the same area.[83] Army and Marine units fighting in close proximity relied on two distinct TACS systems to provide CAS. As the air effort intensified to relieve the siege at Khe Sanh, 7th AF repeatedly requested OPCON of all the air assets required to support the operation, as well as the TACS system needed to manage execution. On 8 March 1968, CINCPAC authorized the Single Management System for Air, which gave the 7th AF commander operational control of all air assets in South Vietnam.

Under the provisions of this system, Marine aircraft were still to be used as much as possible in support of Marine ground forces. However, CINCPAC directed the III MAF commander to make available strike, reconnaissance, and tactical air control system personnel to 7th AF.[84] Marine sorties were added to the weekly and daily frags, and the Marine commanding general provided liaison personnel to the 7th AF TACC and the DASC in the I Corps region. Additionally, the Marines' radar units became subordinate to the CRPs in the Da Nang Subsector (Figure 5, call sign Panama). Although many details would take months to iron out, the Single Manager for Air System greatly increased the airpower available to the 7th AF Commander.

Command-and-Control Structure: Data Links and Information Flow

By the end of 1968, the TACS system in Southeast Asia had matured to the extent

[8181] *Single Manager for Air in SVN*, (AU Library # M-U 38245-62, Project CHECO Southeast Asia report 18 March 1969), 1. (Hereafter *Single Manager*).
[82] *TACS Brief*, 39-40.
[83] Lane, *Command and Control and Communications Structures in Southeast Asia,* 83.
[84] *Single Manager*, 9.

that it provided the 7th AF Commander with a robust capability to command and control all air assets in South Vietnam as well as the Air Force assets operating in North Vietnam. However, most of the radar sites and command centers still relied on voice communications, either telephone or radio, to share information. A long-term goal of 7th AF was to share information across the sites via automated data link systems. In 1968 Lt. Gen. Momyer wrote to the Secretary of the Air Force:

> It has long been my desire to centralize air resources management, tasking, and decision-making at my command centers. This will soon be a reality with the assistance of automated systems, which will permit me and my staff to selectively monitor all air operations.[85]

Project SEEK DAWN was the initiative to automate the existing manual systems. The Navy had a capability to connect its shipboard and some airborne radars with the Naval Tactical Data System (NTDS). Likewise, the Marines had a rudimentary data link called the Marine Tactical Data System (MTDS). The goal of SEEK DAWN was to accept the NTDS and MTDS information, as well as the College Eye AWACS and Rivet Top aircraft's data, and to process and display the information at the 7AFCC at Tan Son Nhut Airbase.[86] As the number of air missions increased, automation of the vast amount of data from all of the various sources became imperative. However, one of the major problems for the 7th AF commander involved having two main command centers — a joint US/Vietnamese facility for in-country operations (7th AF TACC) and the US-only command center for out-country ops (7AFCC). As the operations section of the 7th AF TACC noted:

> The 7 AF Commander received a briefing every evening on the tactical air operations, which had transpired during the day and those planned for the next day. A portion of the briefing, however, was historical in nature. None of the five existing or planned control centers at Tan Son Nhut gave or was planned to give the commander, in a single facility, a comprehensive overview of the total war at any given time.[87]

This situation would improve little by Linebacker II operations in 1972.

---

[85] *C2 in SEA*, VI-1-15.

[86] Lane, *Command and Control and Communications Structures in Southeast Asia,* 77.

[87] *7th TACC*, 61.

Linebacker II

In the fall of 1972, President Nixon and his National Security Advisor, Dr. Henry Kissinger, sought a negotiated peace with the North Vietnamese government. On 23 October 1972, Nixon directed a cease-fire and called a halt to the Linebacker I bombing of North Vietnam. Kissinger met with North Vietnamese negotiator Le Duc Tho in Paris to resolve differences and develop a peace accord. Through November and into December, the two could not agree on the details of a peace. In mid-December Kissinger, in a letter to President Nixon, asked him to, "turn hard on Hanoi and increase pressure enormously through bombing and other means."[88] Nixon ordered a new bombing campaign against North Vietnam to begin on 18 December.

Many of the organizational problems set in place years earlier would continue to complicate execution of the air campaign. The force structure had changed significantly over the years. President Nixon's plan for Vietnamization of the war had effectively terminated US ground combat operations by June 1972.[89] By August there were no more US ground troops in Vietnam.[90] As a result, air power was to play the dominant role in any further operations against the North Vietnamese. By the time Linebacker II began, over two hundred B-52s had arrived in theater. As before, these aircraft remained under the operational control of SAC. SAC headquarters picked the bombing targets in North Vietnam, passed them to the JCS for White House approval, and then sent the details to 8th AF HQ on Guam for planning. The majority of the B-52 sorties were planned as night attacks. 7th AF had the responsibility to provide support aircraft as escort, SAM suppression, and electronic counter measures (ECM) during the B-52 raids. For targets other than those tasked to the B-52s, 7th and TF-77 still had distinct areas of responsibility. A coordinating committee headed by the 7th AF commander included representatives from MACV, SAC ADVON, and TF-77 (Figure 3). The committee provided the detailed coordination and deconfliction of assets required to execute the

---

[88] Henry Kissinger, *The White House Years* (Boston: Little, Brown, 1979), 1393.

[89] *USSAG/7AF in Thailand (1973-1975): Policy Changes and the Military Role*, (AFHRA K717.0413-103: Project CHECO, 27 Jan 79), 22. (Hereafter *USSAG/7AF*)

[90] Momyer, *Air Power in Three Wars*, 333.

missions.[91]

By 1972 the ground-based radars of the TACS system could still not provide adequate coverage above the 19th Parallel. Additionally, there were still many gaps in the coverage along the Laotian border. Consequently, positive control of aircraft by the ground sites was severely limited.[92] The College Eye aircraft provided the capability to surveil a portion of North Vietnam; whenever aircraft flew above the 20th Parallel, an AWACS platform was always on station. Its radar, however, was optimized for use over the water. When looking inland, it suffered from severe degradation by the reflected returns off the ground.

The SEEK DAWN project had made advances in automating the flow of data. However, by 1972, only one facility, the TACC-NS, was capable of integrating all of the various sensor inputs. One other facility, with a slightly different function, had also been completed and assisted in the air campaign. Teaball was a fusion center located at Nakhon Phanom Air Base in Thailand that received data-linked SIGINT information from a variety of sources and used it to pass information on hostile aircraft threats to US aircraft. As Air Force aircraft entered North Vietnam, they would come under the control of TACC-NS for instructions and control. If threats appeared, Teaball would assume control and give threat warnings. By using the AWACS, ABCCC, and Radio Relay Aircraft, Teaball, and TACC-NS had sufficient capability to monitor the progress of the missions, although problems with communications, detailed below, hampered execution. The TACC-NS acted as the forward-most extension of the 7AFCC.

Lt Gen Momyer's efforts to install a fully automated system of data links, giving his 7AFCC the capability to monitor the complete air campaign in near-real-time,[*] had met with increasing difficulties. In 1970, 7th AF had concluded that the air war in Vietnam had terminated and would not likely resume.[93] Subsequently, 7th AF closed the

---

[91] Momyer, *Air Power in Three Wars*, 106-107.

[92] Ibid., 151.

[*] Defined by JP 1-02 as, "Pertaining to the timeliness of data or information which has been delayed by the time required for electronic communication and automatic data processing. This implies that there are no <u>significant</u> delays." 292.

[93] *Southeast Asia Tactical Data Systems Interface*, (AFHRA K717.0414-51: Project CHECO Southeast Asia Report, 1 Jan 1975), 19. (Hereafter *SEA TDS*)

ATACC-NS at Udorn AB, Thailand, in December of 1970. Creating a fully automated system was costly; and, after two back-to-back cost-benefit studies requested by then Chief of Staff of the Air Force, General John D. Ryan, 7th AF recommended that the TACC-NS be closed and that the radar systems revert to manual operations.[94] A subsystem of the SEEK DAWN program, SEEK VIEW, would have given the 7AFCC a near-real-time display capability of the air situation as transmitted from the TACC-NS on Monkey Mountain at Da Nang, the forward-most Air Force ground radar site. However, in the fall of 1970, 7th AF cancelled the program after advising PACAF that the cost was "prohibitive in view of the probable limited time the requirement will exist."[95]

As a result, in 1972 the TACS system was little improved over that available in 1968. The 7AFCC still required verbal reports of the unfolding air battle to maintain its situational awareness and relied on grease boards and timing charts to display the information. TACC-NS had a rudimentary capability to receive information on the air picture from NTDS, MTDS, AWACS, ABCCC, and Rivet Top. Teaball integrated various SIGINT technologies to give early warning of hostile aircraft in North Vietnam to aircraft above the 19th Parallel; however, even they lacked the automated equipment to process and display a real-time picture.[96] Supporting agencies provided updates to Teaball on friendly and enemy positions every minute. Teaball would then make tactical control decisions from these plots.[97] The critical link in this system, however, was the ability to transmit information from the ground command-and-control agencies to aircraft over hostile territory. The Radio Relay Aircraft was supposed to fill this gap. In execution, however, the reliability of the RRA proved poor. The RRA had to operate over vast distances and was tasked to provide not only a voice-relay capability between the ground radar sites and friendly aircraft, a distance of over 250 miles, but also to link the Navy ships in the Gulf of Tonkin with the ground sites. Pilots flying in North

---

94 Ibid., 23

95 Ibid., 31.

96 USAF Tactical Fighter Weapons Center, *Project Red Baron III: Air-to Air Encounters in SEA*, Vol. I, June 1974 (AFHRA K417.0735-7), 26. (Hereafter *Red Baron Vol. I*)

97 *Linebacker Operations September – December 1972*, (AFHRA K717.0413-102 Project CHECO Office of History HQ PACAF, 31 December 1978), 50. (Hereafter *Linebacker Ops*)

Vietnam constantly complained about intermittent communications with Teaball and Motel (TACC-NS).[98] The communications problems greatly increased during Linebacker II when B-52 and EB-66 aircraft regularly turned on their jammers, often interfering with friendly voice channels.[99]

These command-and-control structures during Linebacker II effectively left 7AFCC without a capability to monitor and control the execution of the air campaign directly while it was in progress. This task fell to the TACC-NS, and for certain tasks, mostly the air-to-air battle, to Teaball. 7AFCCs main function during Linebacker II lay in coordinating the missions and producing the daily frag. Two problems exacerbated 7th AF capabilities to monitor execution. First, as part of the Vietnamization campaign, 7Th had greatly reduced its staff from 1,200 personnel to five hundred and had split these between two headquarters locations; one was at Tan Son Nhut AB, while the other was collocated at MACV headquarters.[100] The second problem was due to the changed nature of the campaign itself. Whereas prior bombing of North Vietnam under Linebacker I adhered to the Route Package system and had been primarily an interdiction operation directed against supply routes, Linebacker II concentrated airpower against targets in Hanoi and Haiphong Harbor, greatly increasing the need to provide detailed planning of support aircraft and to eliminate conflicts among missions in the small target area.[101]

Authority for the execution of the Linebacker missions was made at the TACC-NS. Although battle commanders at TACC-NS continued to provide information back to 7AFCC as it developed, they increasingly made more and more decisions as time lags for decisions between the two command centers increased.[102] In earlier strikes a general officer had participated directly from TACC-NS as a forward coordinator for 7AFCC; however, none were in place during Linebacker II, leaving TACC-NS as the agency with the most, albeit intermittent, information on the current situation and with the means to

---

[98] *Red Baron Vol. I*, 25.
[99] *SEA TDS*, 27.
[100] *Linebacker Ops*, 18 and *USSAG/7AF*, 21.
[101] *Linebacker Ops*, 55.
[102] For detailed information from Battle Commander duty officer logs see *SEA TDS*, 29-30.

communicate with the aircraft.[103]

Analysis

The author chose Linebacker II as a case study for the effects of technology on decentralized execution because it establishes a baseline for a mature theater of war with an air campaign using what, at the time, were the latest technological capabilities in sensor and communications equipment. There are two key variables postulated in the introduction as affecting the level of decentralized execution: sensors, which make information on the unfolding air battle available to commanders at a rear headquarters, and communications capabilities, which allow them to transmit their decisions to the airborne package. 7th AF had created a Tactical Air Control System involving ground radar sites, airborne radars, signals platforms, and liaison elements in various lateral organizations to maintain command and control of aircraft involved in the campaign. Organizational decisions made after 1968, on such issues as automated data processing upgrades, shared information among sites via data links, and personnel reductions, precluded the system from having the robust capabilities to share information as envisioned by the then 7th AF commander.

In fact, the priority of every 7th AF commander had been the issue of centralized control of the air assets under his command.[104] Divided responsibilities in the organizational command-and-control structure precluded implementation of truly effective command-and-control systems. The problems of an operational level air commander unable to exercise operational control of forces in his area of responsibility plagued the staff at 7th AF for years. Within the Air Force, the decision to maintain OPCON of the B-52s under SAC added to the complexity of 7th AF's problem. It was perhaps the lethality of force that the B-52s represented in their dual role supporting the air campaign in SEA and the SIOP as well that led to such tight reins on their operational chain of command.[105]

Air operations in Vietnam were spread over a large geographic area. This large

---

[103] Ibid., 31.

[104] Momyer, *Air Power in Three Wars,* 102-103 also *Single Manager*, 52-53.

[105] Ibid., 145.

area, along with the multiple command centers involved, and manually operated communications and data-link systems acted together to force decentralized execution of air operations at levels below that of the theater air commander. Occasional glimmerings of automated information technology showed a potential for future centralized execution. However, because those technologies were only beginning to emerge in the closing months of active American involvement, their potential was never fully tested. Thus, decentralized execution remained the only viable alternative for air operations during the Vietnam War.

Responsibility for the execution of the Linebacker II missions then devolved to lower echelons of command that did have both the means to monitor the flights and the communications capability to pass decision information to the aircraft. Even at the level of the TACC-NS and Teaball, communications proved sufficiently poor and tactical information limited enough, that the majority of their work centered on the air-to-air battle, coordinating post strike refueling, and border warnings as aircraft approached Chinese airspace.[106] These measures, force protection as we would call them today, became the focus of the command-and-control structure. Because information was not readily available at the 7AFCC (a situation which necessarily increased uncertainty of the actual unfolding of events) responsibility for execution was appropriately delegated to lower levels of command. The higher echelons of command concentrated on the broader operational concepts involving *what* the air campaign should accomplish, while lower echelons decided *how* to accomplish the mission. Although improved sensor and communications technologies were just beginning to become available to the command centers, the limitations of the equipment in place during Linebacker II precluded a true capability in centralized execution. The implications of a capability for the air commander's control center to receive more detailed information on the actions of the enemy and the concurrent ability to monitor and communicate decisions to his forces will be the subject of the following chapter on Desert Storm.

[106] *SEA TDS*, 46-50.

Chapter 4

COMMAND AND CONTROL DURING DESERT STORM

20/1030Z

An amazing event has just occurred: We were able to talk secure, direct to all four AWACS, simultaneously and one at a time. We also had an air picture from coast to coast at the same time. Unheard of.

20/1031Z

The Navy just dropped out of the air picture. Perfection didn't quite last as long as hoped for.

TACC current operations log, Riyadh - 20 February 1991

In the almost twenty years between the end of the Linebacker campaigns and the start of Desert Storm, great changes had taken place in the command and control of airpower. Perhaps the most significant was recognition in 1986 by joint doctrine of the Joint Forces Air Component Commander (JFACC). JCS Pub 1 in 1987, the one in force during Desert Storm, defined the JFACC's duties:

> The joint force air component commander's responsibilities will be assigned by the joint force commander (normally these would include, but not be limited to, planning coordination, allocation, and tasking based on the joint force commander's apportionment decision). Using the joint force commander's guidance and authority, and in coordination with other Service component commanders and other assigned or supporting commanders, the joint force air component commander will recommend to the joint force commander apportionment of air sorties to various missions or geographic areas.[107]

The selection of a JFACC was based not on service affiliation, but upon the resources each component made available to the air campaign. Joint Publication 3-01.2 defined the following criteria for the selection of the JFACC: "normally, the joint force air component commander will be the Service component commander who has the

[107] JCS Pub 1, *Department of Defense Dictionary of Military and Associated Terms*, 1 June 1987, 201.

preponderance of air assets to be used and the ability to assume that responsibility."[108] A JFACC, then, had not only to provide the resources to fight, but also had to be in possession of a command-and-control structure that could employ these assets as well. Desert Storm was to be the first combat test case of this concept. As the first log entry above indicates, the Air Force had made significant technological advances in its ability to command and control airpower. However, one minute after the historic event, technology proved itself a fickle servant.

History of Command Organization (1986-1991)

United States Central Command (CENTCOM) had its roots in the Rapid Deployment Joint Task Force (RDJTF) set up under President Jimmy Carter. As a Joint Task Force, the RDJTF was initially envisioned as a temporary measure to give the United States a power projection capability into the Middle East.[109] During the early 1980s, the Reagan administration determined that a permanent unified command should take responsibility for US interests in the Middle East and the Horn of Africa. On 1 Jan 1983, President Reagan activated CENTCOM.

As a unified command, CENTCOM drew component commanders from each of the services. However, these component commanders did not have forces assigned to them, relying instead upon the National Command Authorities to allocate forces to CENTCOM in an emergency. As a result, CENTCOM operated primarily as a planning and headquarters staff without the benefit of exercising with assigned forces. It suffered from a lack of continuity by having no permanently assigned forces and an AOR that was characterized by long lines of communication, lack of regional bases, few forward-based assets, and a shortage of people who understood local conditions.[110] The Air Force component of CENTCOM was 9th AF based at Shaw AFB, South Carolina.

---

108 JCS Pub 3-01.2, *Joint Doctrine for Theater Counterair Operations*, 1 April 1986, III-4.

109 Jay E Hines, "Confronting Continual Challenges: A Brief History of the United States Central Command**,"** lecture 2nd International Conference of Saint Leo College's Center for Inter-American Studies, 19 March 1997.

110 Ibid.

9th Air Force performed wartime duties as the Central Command Air Forces component (CENTAF). Based in the United States, 9th AF had individual fighter wings assigned to it. However, once activated as CENTAF, 9th AF would become responsible for many more and different types of aircraft than under its normal peacetime functions as a numbered air force. To manage air campaign planning and operations, 9th AF had created the 507th Tactical Air Control Wing (TAIRCW) as the agency that would operate the TACC during wartime. As a peacetime organization, the 507th did not have sufficient personnel to operate a fully functioning Tactical Air Control Center; and it relied on large numbers of liaison officers and temporary duty (TDY) personnel to augment its staff.[111]

Although the function of the JFACC had been written into joint doctrine, disagreements on the scope of his duties persisted among the services. Similar to arguments between Air Force and Marine commanders during the siege of Khe Sanh, the issue of operational control of Marine air assets continuously surfaced. In the same message wherein the JCS first authorized the creation of a JFACC in joint doctrine, an addendum noted that:

> The Marine Air-Ground Task Force (MAGTF) Commander will retain operational control of his organic assets….The MAGTF Commander will make sorties available to the Joint Force Commander, for tasking through his Air Component Commander, for air defense, long-range interdiction and long-range reconnaissance. Sorties in excess of MAGTF direct support requirements will be provided to the Joint Force Commander.[112]

In 1986, this policy came to be known as the "Omnibus Agreement," which partially alleviated the Marine Corps' concern that its aviation assets could be taken from the control of the MAGTF commander. This wording from the Omnibus Agreement found its way into JCS Publication 26 and would cause friction between senior commanders during Desert Strom.

As debates between the service staffs continued between 1986 and 1988, CENTAF had the responsibility to create an Operational Plan (OPLAN) for CENTCOM.

---

[111] James A. Winnefeld and Dana J. Johnson, *Joint Air Operations* (Santa Monica, CA: RAND, 1993), 111.

[112] Thomas C. Hone et al., *Gulf War Airpower Survey*, Vol.1 Part II, *Command and Control* (Washington D.C.: US Government Printing Office, 1993), 359. (Hereafter *GWAPS C2*).

OPLAN 1021-88 defined key relationships and duties associated with the JFACC in CENTCOM's AOR. The plan designated the CENTAF commander the JFACC, the Airspace Control Authority (ACA), the Area Air Defense Commander (AADC), and the coordinating authority for interdiction.[113] Each of these responsibilities required an enormous investment in equipment ranging from radios to computer systems that would integrate the various planning and execution-level efforts as well as training requirements to achieve interoperability. Because both 9th AF and the USAF were committed to giving the JFACC given responsibility to direct the theater-wide air effort, they had invested heavily in automated systems. Sister services, especially the Navy and Marine Corps, continued to view the JFACC as a coordinator rather than an actual commander and resisted investing in the required infrastructure.[114] When Iraq invaded Kuwait in August 1990, a revised plan, 1002-90, addressed some of the other services' concerns by giving the JFACC responsibility to "coordinate with the component commanders to ensure integration of air operations."[115]

On 2 August 1990, Iraqi forces crossed the border into Kuwait and captured Kuwait City within six hours. President Bush met with senior advisors that morning. Within two days he received a detailed brief on the provisions of OPLAN 1002-90 from the CENTCOM and CENTAF commanders.[116] As mentioned above, CENTCOM had no standing forces assigned to it and neither did it have forward bases prepared for staging in Saudi Arabia. The only immediate options available to the President were retaliatory strikes by F-111s and F-16s assigned to European Command (EUCOM) on temporary duty in Turkey, or to wait for two aircraft carriers to arrive in the Red Sea and Gulf of Oman.[117] On 8 August 1990, after gaining the approval of the Saudi government to base US and coalition forces within the kingdom, U.S. F-15s landed at Dhahran AB while US

---

[113] Ibid., 364.
[114] Winnefeld, *Joint Air Operations*, 110.
[115] *GWAPS C2*, 367
[116] For excellent discussion on the national security decision making during the crisis see Bob Woodward, *The Commanders* (New York: Simon and Schuster, 1991), 202-44.
[117] Williamson Murray, *Air War in the Persian Gulf* (Baltimore, MD: The Nautical & Aviation Publishing Company of America, 1995), 9.

AWACS aircraft arrived at Riyadh AB.[118] By 17 January 1991, when the first air attacks

against Iraq began, there would be over 1,100 USAF aircraft in theater.[119]

In contrast to the convoluted chains of command that plagued the senior officers in Vietnam, the command organization for prosecuting the war against Iraq was greatly streamlined. In 1986 the Goldwater-Nichols act had significantly reduced the role of service chiefs in operational planning and execution, while concurrently increasing the role of theater CINCs.[120] In strengthening the role of the CINCs, Goldwater-Nichols specified that the command authority of the CINCs included the ability to prescribe the chains of command of assigned forces, to include their organization, as well as their employment and the command responsibilities of subordinate commanders.[121] This authority, defined as combatant command (COCOM) in Title 10 of the US Code, along with the previous arrangements for the conduct of air operations written into OPLANs 1021-88 and 1002-90, would have significant influence on the command and control of airpower during the war.

One of the major organizational differences between the conflict in Vietnam and Desert Storm was in the relation between the CINC and the air component commander. Whereas CINCPAC had a Major Command (PACAF) four-star general as his primary Air Force component, CINCCENT had a Numbered Air Force commander, a three-star general. CINCPAC had separate chains of command for Air Force and Navy components bombing targets in North Vietnam as well as the SAC assets that were tasked from outside of the theater. CENTCOM adopted a single manager for all of the air assets in theater. Additionally, unlike CINCPAC during Vietnam, CINCENT deployed to the forward area and established his headquarters in Riyadh to be as close to the battlefield as possible. One of the most significant differences between the two campaigns, however, was the total operational command of airpower given to CINCCENT in Desert Storm. On 22 October 1990, the Chairman of the Joint Chiefs of Staff sent a message to all combatant commanders to clarify his authority:

> 1. Tactical Air Force units deployed to the USCENTCOM AOR are reassigned COCOM to USCINCENT unless COCOM was or is specifically designated to another command in the deployment order.
>
> 2. CINCSAC B-52s supporting Desert Shield are attached OPCON to USCINCCENT. CINCSAC support assets (such as tanker aircraft) will be provided in support of or TACON to USCINCCENT, as

directed by the Deployment (Air Tasking) Orders.

3. When directed, USTRANSCOM airlift personnel and assets are attached OPCON to USCINCCENT.[122]

In contrast to the chain of command during Vietnam, the results in Desert Storm were greatly simplified (see figures 5 & 6)

.

Figure 5. C2 Organization for Air Operations in SEA (Momyer)

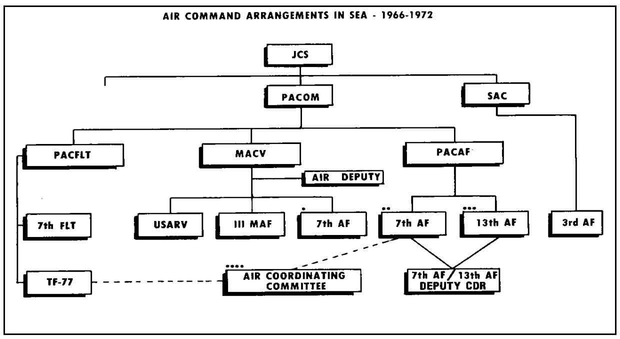
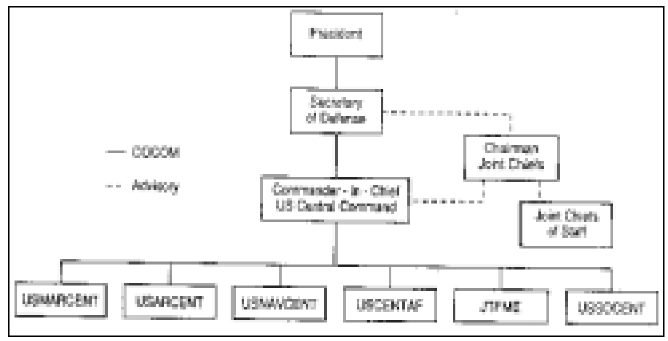


Figure 6. C2 Organization for Air Operations in SWA (GWAPS C2)



The 9th AF Commander, in his additional role as Central Command Air Forces commander, was the natural choice for CINCCENT to delegate tactical control of the air assets assigned to the theater. However, issues that remained unanswered from the Omnibus Agreement, as well as the still unresolved question as to whether the JFACC was an operational commander or coordinator, caused initial problems for the JFACC with sister services.[123] Senior Marine commanders were still apprehensive that the JFACC concept would drain Marine Corps aircraft from their traditional role of providing direct support to Marine ground units.[124] Senior Navy commanders proposed that the services split Iraq into designated Areas of Responsibility akin to the Route Packages used in Vietnam.[125] To preclude divisive efforts and parallel air campaigns, the CENTAF commander used the Air Tasking Order process to control all aircraft flying within the Kuwaiti Theater of Operations (KTO). As the Airspace Control Authority and the Area Air Defense Commander, CENTAF adapted the existing Saudi Arabian air defense system to ensure that all aircraft entering the KTO be tasked via the ATO. The Saudis insisted on a single management tool by which they could ensure their system would operate safely. The ATO process met that need and was directive in nature. Production of the ATO would be one of the chief duties of personnel in the TACC and led the CENTAF commander to note that,

"without the ATO, you don't have a JFACC. With the ATO, you don't have anything but a JFACC."[126]

Command-and-Control Structure: Tactical Air Control System

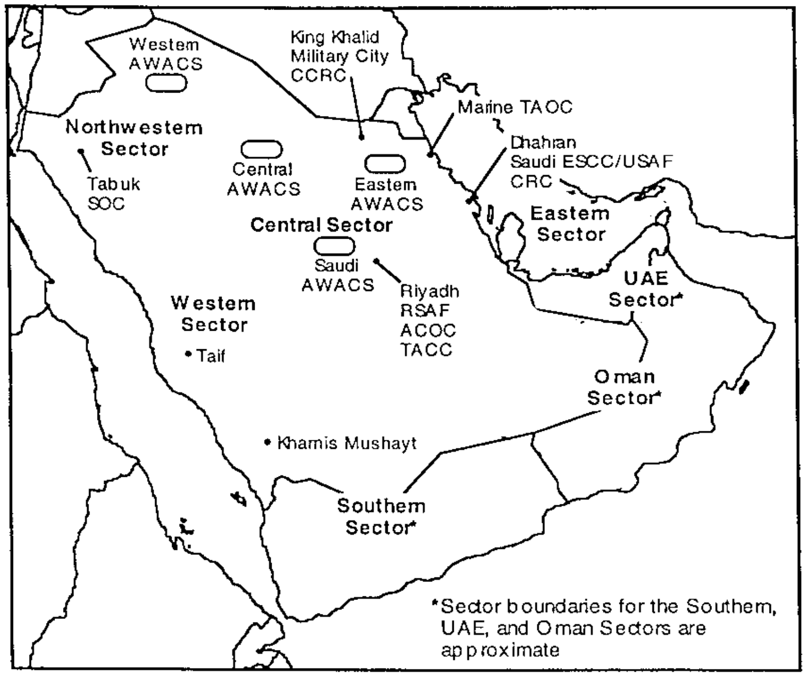
The Tactical Air Control Center in Riyadh was to become the focal point for planning, direction, and coordination of all theater air operations. The 507th Tactical Air Control Wing's TACC arrived in Riyadh on 14 August 1990 and became operational on 18 August.[127] Similar in concept to the TACCs in Vietnam, the 507th TACC had the luxury, unlike its predecessor, of being the single command center for the theater. The TACC had two major operations sections. The Combat Operations Division's primary duty was to monitor execution of the current day's ATO, ensuring that any changes and coordination required would be taken care of on behalf of the JFACC. The Combat Plans Division planned the following two days' ATOs, ensuring that the air campaign met the objectives set by the JFACC. Production of the ATO was primarily the duty of Combat Plans, while real-time execution monitoring of the ATO was the duty of Combat Operations. Other divisions within the TACC included Intelligence sections to correlate data and conduct bomb damage assessments and liaison staffs representing the other services.[128]

Many of the other elements of the TACS were similar to those discussed in Chapter Three, although most had undergone significant technical enhancements; and the relationships among the elements had changed. Two Control and Reporting Centers (CRC) deployed to the theater. One was located in Dhahran and the other at King Khalid Military City (KKMC) (figure 7).[129] Unlike their Vietnam counterparts, the CRCs in Desert Storm provided limited control of aircraft and were primarily tasked to interface with the Saudi Arabian Air Defense network providing the link between the TACC and the Army Patriot and Hawk missile batteries in theater.[130] The primary element of the TACS for radar coverage of the KTO was the E-3 AWACS, a modified Boeing 707 platform performing the roles that the EC-121 Constellation had in Vietnam. Having arrived in theater with the first contingent of US fighter aircraft, the AWACS platforms initiated 24-hour radar coverage of the KTO weeks before the TACC had become operational. This was especially important during the early days of Desert Shield, when commanders expected an imminent invasion of Saudi Arabia by Iraqi forces.[131] Additionally, the Saudi's possessed similar AWACS aircraft that became integrated into the theater TACS. EC-135 Rivet Joint aircraft, also modified Boeing 707 airframes, provided improved SIGINT

capabilities over their predecessor in Vietnam, the EC-121 Rivet Top. ABCCC also aircraft deployed to the desert and performed functions similar to their role in Vietnam for Close Air Support.

By 1990, data link technologies for the Tactical Air Control System had greatly improved. Three main types of data links transmitted information to the TACC. The first was the Tactical Digital Information Link A (TADIL-A). It was the most common system of sharing radar information between the Navy, Marines, AWACS, and the TACC. The second was the Tactical Digital Information Link B (TADIL-B), which was the primary data link system used to share information between the CRCs and Army and Marine Air Defense Units. The third system in use was Joint Tactical Information Distribution System (JTIDS), which was used by AWACS and some Army ADA units.[132] Each of these systems had unique capabilities and limitations. TADIL-A operated primarily on an HF frequency that allowed the many units, beyond line-of-sight of one another, to share data, to include the TACC. Due to the use of HF frequencies, however, the system could not handle a large volume of data and was susceptible to atmospheric disturbance.[133] When needed, TADIL-A could also be broadcast over a UHF line-of-sight radio. While this increased reliability, it also reduced the operational range of the unit broadcasting the information, a limitation that would cause operational difficulties discussed below. TADIL-B was also a line-of-sight system that was restricted to use by ground elements of the TACS to share data and forward information to the TACC. JTIDS provided a higher volume of data transfer, but was limited because so few elements were equipped with JTIDS units.

Figure 7. TACS Elements in SWA (GWAPS C2)



By 1990, Lt. Gen. Momyer's vision of enabling the TACC to monitor all air operations from the TACC had made significant advances. The TACC in Riyadh contained a pre-production Deployable Air Situation Display System (DASD).[134] Located at the front of the Combat Operations room, two DASD consoles, essentially large screen televisions over seven feet high, displayed the data-linked air picture from AWACS to the Fighter Duty Officers (FDO). The first DASD received that TADIL-A picture from the central AWACS (figure 7). In order to maintain a reliable UHF data link to the TACC, the central AWACS had to maintain a line-of-sight orbit to a relay station set up at King Khalid Military City. This line-of-sight requirement essentially "tethered" the AWACS to the relay site and limited the operational range of its radar to support strike packages moving north into Iraq.[135] The second DASD received information from the Tactical Information Broadcast System (TIBS), which augmented the AWACS surveillance information with SIGINT data collected by the Rivet Joint. As the duty officer logs at the beginning of this chapter noted, however, the dependability of both displays proved unreliable. Due to the numerous configurations possible between the three types of data links, no one architecture was dominant and no one method of integrating all of the data remained in force for long.[136] As the requirements for data increased and the number of users grew, so too did the complexity of the system and the number of reconfigurations of the data-link architecture. Although the TACC was the focal point for air operations, numerous other users required information on the unfolding air war, to include Navy ships in the Red Sea and Persian

Gulf, Marine Tactical Air Operations Centers, and the aforementioned CRCs. At times the TACC was both a recipient of information from, as well as a source to, other data-link members.[137] The DASDs were, however, the best system in place for the JFACC to maintain a complete air picture.

The other key technology affecting the Gulf War was communications capability. Desert Storm was a watershed event for communications officers, who constructed the largest tactical communications system in USAF history.[138] The daily ATO required over nine hundred frequencies, and resolution of conflicting frequencies was a constant problem.[139] To preclude frequency conflicts that would disrupt command and control of the air war, the JFACC staff received an additional responsibility to ensure that all theater participants adhered to a common communications plan. One of the most difficult challenges for the TACC staff was maintaining communications to the airborne elements of the TACS. Due to the limitations imposed by the locations of the ground CRCs in their ability to provide command and control data, the airborne elements took on a much more important role in Desert Storm than they had in Vietnam.[140] High Frequency communications proved unreliable at best.[141] The use of UHF communications increased reliability but also imposed the operational limitation on the E-3 orbit discussed above. One solution to the TACC's problem of communicating with its airborne elements was the use of Ground-to-Air Transmission (GATR) sites. These ground sites, essentially radio repeaters that would re-broadcast voice communications, provided the TACC with an ability to communicate with all airborne TACS elements throughout the theater.[142] CENTAF established three such sites at KKMC, Rahfa, and Al Jubail airfields. These provided the TACC with the ability to communicate directly with all three of the on-station AWACS.[143] Tactical Satellite (TACSAT)* communications were available, but a number of technical problems precluded their use between the TACS elements and the TACC.[144]

The final problem for the TACC involved communications systems for the ground war. Both AWACS and ABCCC provided critical information to the TACC, as well as forwarding command instructions from the TACC to the ASOCs located with the three army corps (18th Abn Corps, 7th Corps, and the Joint Forces Corps-North) and their associated TACPs. To meet the particular communication needs of army units (UHF/AM and VHF frequencies), the Air Force once again requested Radio Relay Aircraft for the theater. Two EC-130 Airborne Command Center/Command Posts and SAC EC-135L aircraft provided the final connection for the TACC

to link with the airborne elements of the Tactical Air Control System.[145] The RRA's in Desert Storm were much more reliable than they were in Vietnam and provided much needed assistance between TACS elements and strike missions conducted deep in Iraq.[146]

Recognizing that real-time command and control connectivity with the airborne elements of the TACS was susceptible to disruptions, the CENTAF staff also formed Airborne Command Element (ACE) teams. These teams contained five officers from the TACC staff that flew on board the central AWACS and acted as airborne extensions of the JFACC, with command authority to ensure execution of the ATO if connectivity to the TACC were lost.[147] The senior officer of the ACE Team, an Air Force Colonel, acted as the Mission Director responsible for executing the CENTAF commander's guidance, especially in interpreting and executing the Rules of Engagement. Other duty officers included Fighter, Intelligence, Tanker, and Electronic Combat Duty Officers, as well as a Navy Liaison Officer. The primary responsibility of these TACC members was assist to in air defense, warning and control for strike packages, and tanker force management.[148] In the event of lost communications with the TACC, these officers had the authority to re-direct packages to higher priority targets as required and to commit forces.

Technological advances had greatly improved in the twenty years since the end of the Vietnam War. Additionally, command arrangements in Desert Storm were streamlined, allowing for a unity of air effort under the direction of a single air commander. At their command post, the Tactical Air Control Center, the CENTAF staff expended enormous energy ensuring that the quality of data available to the JFACC was as timely and as accurate as possible, as well as the providing him a capability to transmit mission changes to airborne units. Due to its central location as the hub of air campaign planning, the TACC also became the focus for national level intelligence to the theater as well as the enormous amount of Bomb Damage Assessments from the flying units. During particular missions, such as those against the mobile theater missile threat, the investment in improved command and control capabilities paid enormous dividends and allowed the TACC to rapidly adapt to changing battlefield conditions.

By the fourth day of the air war, the threat posed by mobile SCUD missiles began to exert enormous political pressure on the theater commander.[149] The TACC diverted over 2,600 airborne sorties from other missions during the conflict in support of SCUD-hunting.[150] The aircraft tasked against the SCUDs involved over 25 percent of all coalition aircraft tasked in the daily ATO, a mission the JFACC referred to as "a pain in the ass."[151] Unfortunately, the onboard

systems of most coalition aircraft were not well suited for detecting and attacking the SCUD Transporter-Erector-Launchers (TELs) after they had launched their missiles.[152]

The prosecution of SCUD targets was the ultimate test of the theater's command and control system. Once the menace of the SCUDs became apparent and the priority for their destruction set by the political leadership, the full resources of the TACS were energized to combat the threat. Innovative work by two captains from SAC created a system of indications and warnings between SAC, US Space Command (SPACECOM), and CENTCOM that allowed satellite information on the SCUD launches to be relayed to the Patriot batteries in theater within four minutes.[153] This allowed the Patriot missiles to be fired after the SCUD launch, or, as the JFACC noted in his duty log, "One SCUD shot down another of our Patriots…Have not had a successful Patriot launch into Iraq yet."[154] The test for the TACC was to find the TEL sites after a launch to preclude them from being used again.

U.S. F-15Es were the core of the SCUD-hunting aircraft, although A-10s; F-16s; F-111s; and, on one occasion, an AC-130 were also used.[155] The F-15Es were tasked to provide combat air patrol over suspected SCUD-launch sites in four-hour blocks. If the TACC had indications of a launch, information on the location was broadcast to all elements of the TACS via voice communications. Patriot units received data-linked information from SPACECOM on the flight path of the missile, while AWACS crews relayed information to the on-station SCUD-hunters. Joint STARS, a developmental aircraft with an air-to-ground Moving Target Indicator (MTI) radar able to detect vehicles, also monitored these locations for indications of the moving TELs, thus assisting the F-15Es in target acquisition. Of the forty-two SCUD launches upon which the F-15Es committed, the crews were able to acquire visually only eight of them on which they employed ordinance.[156]

Although the effectiveness of coalition Air Forces to attack the mobile SCUD TELs has since been called into question, it was still a remarkable mission performed in an improvised manner by aircrews, TACS elements, and the TACC itself functioning as an orchestrator of the various forces responding to real-time mission changes.[157] The Defense Science Board noted in its Lessons Learned in Operations Desert Shield & Desert Storm:

> There was no doctrine and there had been no training. Procedures and integration were ad hoc and not optimum. Information to enable successful attack should have made a difference…A capability to find and destroy…Scuds before they launch implies a hitherto unachieved integration and a new level of processing or

surveillance data.[158]

The TACC also found it difficult to conduct timely Bomb Damage Assessment (BDA). Numerous studies have faulted the BDA process for the amount of time it took to analyze strikes and to report back to the planners concerning the resultant effects.[159] A March 1991 AF White Paper noted that:

> The inherent speed, range, and flexibility of airpower means that air-war occurs at a very rapid pace. This war indicates that pace is accelerating and now demands unprecedented response from BDA. In order to ensure the proper targets were re-struck in the most efficient manner, BDA had to be both accurate and timely. This requirement is in marked contrast to previous wars where progress was generally measured in terms of weeks or months not hours. Reconnaissance assets were in high demand, however, not only for BDA, but also for Scud sites, chemical weapons sites, and the disposition of Iraqi ground forces.[160]

This statement suggests the importance of the TACC, as the processing and analysis element for BDA, in a new role providing real-time information and direction in prosecuting time-sensitive targets. The command-and-control structure and technologies were in place to allow the TACC to monitor not only real-time execution of the air campaign, but when necessary to communicate direction to the airborne force. What the TACC lacked was the information on both the effects of the strikes and the locations of time-sensitive mobile targets that posed a threat. Information, computing power, and real-time analytic capabilities, however, had not kept pace with the advances in data links, communications, and reconnaissance capabilities.[161]

Desert Storm differed not only in context from the Linebacker II campaign of Vietnam, but quantitatively in the command organization, structure, and technologies of command and control. While both air campaigns saw sustained day and night bombing efforts against the target country, Desert Strom provided a unity of command and effort unparalleled since World War II. The JFACC possessed sufficient authority to establish a span of control over all of the theater air assets tasked to fly against Iraq. Organizationally, the TACS system was modeled on that used during Vietnam; but advances in platforms, links, and communications demonstrated the use of airborne platforms to extend the JFACC's authority as well as to provide his TACC with the requisite information to assess the execution of the air campaign.

By day ten of the war, the ATO tasked over three thousand sorties a day.[162] The ability of the TACC to monitor this activity had improved to the point that large displays provided near real-time information on the tracks of friendly and enemy aircraft locations to the duty officers in

Combat Operations. Communications networks allowed their decisions to be transmitted to the packages instantaneously, diverting aircraft to higher priority targets as required. The Gulf War Air Power Survey (GWAPS) noted that for the first time airborne elements could consult directly with the JFACC and his staff while operations were in progress and could modify the plan immediately.[163] But even with all of the advanced technologies set in place, crucial pieces of information about the location of many targets and the assessments of earlier strikes did not reach key decision-makers in time for them to re-direct the aircraft in flight. This lack of information effectively precluded the TACC from exercising further control. Additionally, unreliable communications led to the creation of Airborne Command Element teams with the authority to act in place of the JFACC of communications with the TACC were lost. While centralized execution was possible during Desert Storm, lack of training and procedures, information distribution problems, and still-unreliable communications did not permit any further centralization of the execution phase. In the following years, the Air Force would expend great energies to overcome these challenges.

Chapter 5

COMMAND AND CONTROL DURING ALLIED FORCE

For the United States, Operation Allied Force provided a real-world test of information superiority concepts outlined in Joint Vision 2010.

Kosovo/Allied Force After Action Report

We have before us something that looks like a radar scope for a joint force air component commander, where we detect targets on the battle field, we lock on to them like we lock on to an enemy aircraft.

John Jumper

The organization of a military force, including its command and control relationships, is a weapon.

Bill Nichols

Desert Storm was a watershed event for the US military. American troops and generals in the desert between August and December of 1990 could not foresee the overwhelming victory they would achieve some three months later. Yet in retrospect their triumph seems almost inevitable. As success breeds success, so too the military concentrated on improving the skills and forces that helped it to achieve victory on the Iraqi desert. In 1996, the office of the Chairman of the Joint Chiefs of Staff published *Joint Vision 2010* (*JV 2010*), a statement about how to exploit developing technological capabilities to increase combat effectiveness.[164] One of the key tenets of *JV 2010* was a belief that improved command, control, and intelligence could produce a situation referred to as information superiority.[165] The key to attaining such superiority were new technological capabilities that would transform warfighting and enable the realization of operational concepts called dominant maneuver, precision engagement, full dimensional protection, and focused logistics.

The Air Force quickly supported the concepts in *JV 2010*. In September 1996,

then Chief of Staff of the Air Force, General Ronald Fogleman, stated that:

> The Air Force fully embraces the 2010 concept…Everyone in the Air Force should read and understand Joint Vision 2010. The Air Force provides the commander the degree of air, space and information superiority needed to deploy, maneuver and engage enemy forces while denying the same ability to the enemy across the entire theater. In other words, deny the enemy any sanctuary.[166]

In September 1997 the Air Force published AFDD-1, its new basic doctrinal manual. It introduced the new Air Force core competencies that included information superiority as a key enabler, allowing full exploitation of military information functions.[167] It declared that:

> Dominating the information spectrum is as critical to conflict now as controlling air and space, or as occupying land was in the past…One of a commander's primary tasks is to gain and maintain information superiority, with the objective of achieving faster and more effective command and control of assigned forces than the adversary.[168]

The Tactical Air Control Centers were re-named Air Operations Centers (AOCs). In the 1995 regulation describing its duties and responsibilities, the AOC incorporated the many new ideas and lessons of improved communications and display technologies from Desert Storm:

> The Air Operations Center (AOC) is the operational facility in which the COMAFFOR/JFACC *has centralized the functions of planning, direction, and control over committed air resources*. The AOC functions at the component or force level, and provides the COMAFFOR/JFACC with the capability to supervise the activities of assigned or attached forces and to monitor the actions of both enemy and friendly forces. In order to operate, the AOC requires connectivity, via communications, to operations centers of higher headquarters, lateral headquarters, and subordinate units. This allows for the continuous collection and presentation of battle management information. This data is used by AOC personnel IAW the priorities, objectives, and strategy of the COMAFFOR/JFACC to *conduct detailed direction of all air resources assigned, attached, or transiting the AOR*.
>
> The battle management function of the AOC is defined as those decisions and actions taken in direct response to the presence or activities of enemy forces. *Essential to this battle management function is the ability of the AOC to accurately perceive and understand the current situation and to make timely and effective decisions for the employment of air assets* and

> theater wide-area SAMs under the control of the AADC. *The battle management function is the most critical activity in the AOC and may ultimately decide the success or failure of the theater forces to achieve their assigned objectives*.[169] (emphasis added).

The AOCs were now designed to take an active role in the ongoing air battle and, by having access to timely information and communications capabilities, to decide the failure or success of the war.

Allied Force

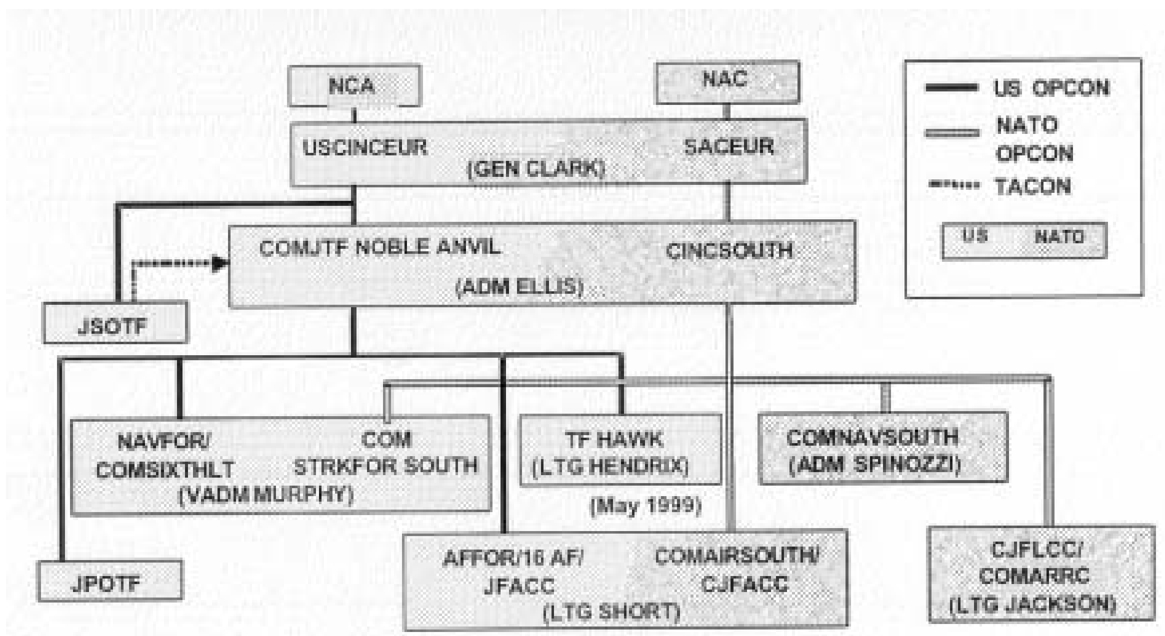
On 24 March 1999, after repeated diplomatic failures and four days after Serbian forces launched a major offensive into Kosovo, driving thousands of ethnic Albanians from their homes and villages, the United States, acting with the North Atlantic Treaty Organization (NATO), began Operation Allied Force.[170] Initially envisioned as a short operation, the aerial bombing of Serbian forces in Kosovo and Serbia lasted for seventy-eight days.[171] Unlike Desert Storm, which relied totally on deployed forces to the theater, Operation Allied Force had the benefit of in-place command-and-control structures that had been established by the United States and NATO for many years.

Many NATO organizations had key commanders with dual-hatted responsibilities. The Commander, European Command (EUCOM), for example, was the theater CINC for US forces. Additionally, he was also the Supreme Allied Commander Europe (SACEUR), a NATO position commanding the full alliance. Subordinate organizations also mirrored the particular dual-command structures of the European theater. In the European Southern Region, A US Navy admiral was the Commander in Chief, Allied Forces, Southern Europe (CINCSOUTH) and had OPCON of the Allied Air Forces, Southern Europe (AIRSOUTH), a NATO command. The commander of AIRSOUTH, a US three-star general, was also Commander of 16th Air Force, a USAF Numbered Air Force. In this capacity, he was also the commander of the Combined Air Operations Center (CAOC) at Vicenza, Italy.

The CAOC was the focal point for the air campaign. Originally activated during the Bosnian conflicts of 1994-1996, the CAOC had become a sophisticated command-and-control center over the years, integrating many critical systems crucial to planning, controlling, and directing air operations. During Allied Force, the staff at the CAOC

grew from four hundred personnel to over 1,300.[172] It managed over two hundred sorties per day at the beginning of Operation Allied Force to over one thousand per day by the end of the conflict. [173] The 16th AF commander was designated as both the Combined Force Air Component Commander (CFACC) in charge of coalition aircraft, and as the Joint Force Air Component Commander (JFACC) in charge of US aircraft (see Figure 8). This distinction would subsequently lead to operational problems with parallel U.S. and NATO command-and-control structures that complicated operational planning and unity of command, similar to the divided responsibilities of air commanders in the Vietnam War.[174]

Figure 8. Command and Control Organization for Operation Allied Force



(Kosovo/Allied Force After Action Report: Report to Congress)

Due to differences among the coalition members over what constituted valid military targets, the approval process for targeting allowed any member of NATO to veto a target.[175] Additionally, the US staff at the CAOC created a separate US-only ATO to be used for strikes using USAF F-117 and B-2 aircraft.[176] In more than a few instances, this led to significant difficulties in the command and control of airpower. NATO possessed AWACS aircraft that were similar to those flown by the US during Desert Storm. As NATO assets, however, they were not privy to the US-only ATO missions

that were tasked against Belgrade. As a result, in at least one instance while monitoring missions during Allied Force, the crews noticed unidentified aircraft (those not in the NATO ATO they had with them) flying out of Hungary. In an excited call to the CAOC, while setting up an intercept for identification purposes, the crew learned back from the CAOC that the aircraft (US planes on the US only ATO which the crew did not possess) were indeed friendly.[177] Unlike Vietnam, however, the 16th AF commander did have operational control over all of the air assets assigned to the theater, to include large bomber aircraft such as B-2s that flew round-trip bombing missions directly from the United States.

Many of the airborne command-and-control systems that flew in Allied Force were the same as those that had participated in Desert Storm. AWACS aircraft, both NATO and US, provided 24-hour radar coverage of the airspace over Kosovo, Bosnia-Herzegovina, and Serbia. Joint STARS aircraft had become operational and provided ground Moving Target Indicator information on vehicles within Kosovo. Rivet Joint aircraft provided SIGINT information throughout the theater. U-2 aircraft provided detailed imagery used for both real-time surveillance and BDA. New additions to the command-and-control structure also provided supplementary information to the CAOC. Predator and Hunter Unmanned Aerial Vehicles (UAVs) provided electro-optical and infrared imagery of the AOR.

The data-link and communications architectures, however, were significant improvements over the capabilities available to commanders in the desert; and they enabled the adoption of unique operational procedures that created opportunities for centralized execution of airpower. The Balkan Operational Picture (BOP) was the key battle management system in place for the CAOC to monitor the execution of the air campaign and integrate the various intelligence sources for information on the AOR. The BOP was displayed on a series of networked computers that received information from all the various Intelligence, Surveillance, and Reconnaissance (ISR) assets in theater, as well as satellite imagery.[178] A principle feature of the BOP was its ability to transmit information not only to the CAOC but also to higher and lateral command centers, as well as to the National Military Command Center (NMCC) in the Pentagon. This capability of rapid and widely disseminated information to all levels of command would

have serious implications in the 16th AF commander's ability to exercise sole control in the employment of airpower.

As the war progressed, commanders were divided over the best targeting strategy to employ against the Serbia. SACEUR wanted the priority of the effort to be placed on the Serbian 3rd Army within Kosovo. The C/JFACC believed that a coercive campaign against the Serbian leadership in Belgrade would have the most influence.[179] To provide a capability against time-critical targets (TCTs) within Kosovo, most of which were the mechanized units of the Serbian 3rd Army, the CAOC instituted a "flex targeting" cell within the combat operations section. This cell was the focal point for all of the ISR-derived information coming from the sensors in theater. During Operation Allied Force, NATO forces conducted strikes against over 3,400 such flex targets.[180] The combined information from the airborne TACS elements provided data to the flex targeting cell that it used to divert strike aircraft from pre-planned targets to the TCTs.[181] The procedure was created to reduce the time from "sensor-to-shooter," with the CAOC operating as the primary information hub that correlated the incoming data, made a decision to strike the target, and assigned it to one of the on-scene strike aircraft. In many cases, the CAOC monitored the target area via UAV feed on one screen, while concurrently monitoring the progress of the strike aircraft on another.[182] Due to the nature of the conflict, avoidance of collateral damage against unintended targets was a high priority for planners and national leaders. As a result, the CAOC closely monitored many of these missions, providing detailed information to the strike aircrews and often withholding authority to launch weapons if the information displays indicated potentially high collateral damage.

The other key enabler of the CAOC as a critical battle management center was the improved communications within the Kosovo AOR. When air operations began over Bosnia-Herzegovina in 1994, the NATO staff had made significant improvements in the ability of the CAOC to communicate with airborne forces. A series of remote Ground-to-Air Transmission (GATR) sites, similar to those employed during Desert Storm, had been placed within the AOR. These robust systems employed both military and pre-existing commercial lines to allow clear and secure communication throughout Bosnia, Kosovo and parts of Serbia. They greatly expanded not only the ability of airborne TACS elements to communicate with the CAOC, but also allowed the CAOC to speak directly

to any of the airborne strike aircraft flying within line-of-sight range of a repeater.[183] Numerous other advances also allowed innovative communications between the CAOC and strike aircraft. The Rapid Targeting System (RTS) allowed the CAOC to send detailed target information and imagery in the form of a television signal directly to the cockpit of F-15E and F/A-18 aircraft, allowing for the strike crews to plan their attack based on up-to-date information. When the crews completed their planning, final authorization was received from the CAOC to allow them to strike their target.[184]

In one of the most telling changes in the CAOC's developing ability to control the execution of ongoing operations directly, the 16th AF commander, under pressure from SACEUR to strike Serbian 3rd Army position in Kosovo, used the command and control resources at his disposal to ensure that three Serbian tanks were destroyed:

> About 5 o'clock in the afternoon, we had live Predator video of three tanks moving down the road in Serbia and Kosovo. As most of you know, my son is an A-10 pilot, or he was at the time. We had a FAC [Forward Air Controller] overhead and General Clark [Gen. Wesley K. Clark, SACEUR] had the same live Predator video that I had. "Mike, I want you to kill those tanks." I quickly responded, I had something else in mind, "Boss, I'll go after that for you." When shift time came, [Maj. Gen.] Garry Trexler was on the floor, finishing up in the daytime, and Gelwix arrived to take the night shift. I was there because the SACEUR wanted those three tanks killed. We had a weapon school graduate on the phone talking direction to the FAC on the radio. Call went something like this: "A lot of interest in killing those tanks, 421. I'd like you to work on it." "Roger." Two or three minutes went by, and 421 clearly had not found those tanks. The young major's voice went up a bit and said, "ComAirSouth, and SACEUR are real interested in killing those tanks. Have you got them yet?" "Negative." About two more minutes went by and the weapons school graduate played his last card. "General Short really wants those tanks killed." And a voice came back that I've heard in my house for the better part of 30 years and he said, "God damn it, Dad, I can't see the fucking tanks!"[185]

Few senior commanders have had such access to real-time ISR data and communications systems that permit instantaneous information of battlefield conditions and the ability to exploit them. Historically, airborne operations have relied on commanders picking fixed targets for destruction, assigning them to a particular unit, and awaiting the results. In cases where targets have been mobile, for example tank columns, or infantry, decentralized operations were required, in which lower level, on-scene personnel,

ostensibly with the best information on local conditions, had execution authority. During Allied Force the level of control and information available to the air commander allowed him to alter the execution of on-going missions. Seldom had entire packages been re-tasked while airborne or had such detailed information on local conditions been available to a rear headquarters, with those on-scene requiring that more detailed information. The concept of an Air Operations center as a weapons system had been born.

The combination of rapid, real-time sensor information to the CAOC, along with a robust communications system that could transmit command decisions by the C/JFACC to airborne aircraft certainly allowed centralized execution of air operations during Allied Force. The C/JFACC had perhaps better information on local conditions than the aircraft involved in the missions. The CAOC was privy and responsive to the priorities of the theater CINC, who also had access to the same information and in-turn ordered attacks against targets he viewed on his displays. While Allied Force demonstrated that advances in sensors, data-links, and communications technologies have made centralized execution feasible, certain lessons on its desirability can be drawn.

Centralized control of airpower suffered anew within the context of a NATO-led effort. Within the alliance, Allied Force was an extremely politically charged effort, as competing priorities on target selection, and national sensitivities to collateral damage, invoked high degrees of National Command Authority level control.[186] Although the C/JFACC was notionally in charge of ATO production and assigning targets to flying units, centralized control also migrated to higher-echelon commands at both the theater and national levels, as the CINC became directly involved in specific targets selection and national leaders maintained veto power over specific targets. Allied Force was a relatively small air campaign, both in geographical scope, and in the number of sorties flown, especially in comparison to both Linebacker II and Desert Storm. As the level of force applied against an opponent requires greater and greater precision by higher-echelon commanders, and sensor and communications capabilities allow close monitoring and control of execution, centralized execution may provide desired capabilities to air commanders.

Chapter 6

CONCLUSIONS AND IMPLICATIONS

Airmen are trained to deal with uncertainty. Uncertainty is a way of life.

John Jumper

This thesis began by tracing the doctrinal evolution of the central airpower tenet of decentralized execution. The American Heritage Dictionary defines a tenet as, "an opinion, doctrine, principle, or dogma held by a person, or, more especially, an organization."[187] Decentralized execution developed in response to perceived restrictions on the freedom of on-scene commanders to act independently in Vietnam in 1971; and in later doctrinal manuals decentralized execution came to represent everything from empowering subordinate commanders to act independently to affirming our heritage as a freedom-loving people.

Decentralized execution itself has a long history and developed in response to changing methods of warfare implemented as the size of armies grew too large for a single commander to direct large forces. Staffs developed to assist commanders in planning and orchestrating the larger armies of the day. One important development of the modern staff was to create systems allowing rapid communication to the forces as well as receiving information on local conditions back at the staff. However, during much of the 19th and 20th centuries, these technologies were insufficient to allow rapid, timely, and comprehensive knowledge for senior commanders to influence tactical level units directly, especially in long-range aerial warfare.

As modern communications and sensor technologies began to be fielded during the Vietnam War, systems and organizations developed to the point that rear headquarters staffs began to have access to increasingly detailed information. The command-and-control structure for airpower during Vietnam precluded effective centralized control of airpower. Not only were aircraft from different services tasked by different command echelons, but multiple command-and-control centers reduced opportunities for integrated

effort and management of information. Emerging command-and-control technologies, however, would have a significant impact on future air operations. A number of ground and airborne sensors began to offer some information during the execution of air missions to control centers. Radar and signals intelligence (SIGINT) played increasingly important roles in directing the effective employment of airpower; however, their use was of most value to the airborne strike aircraft. Communications limitations of both voice and data links kept the Tactical Air Control Centers (TACC) from effectively functioning as real-time directors of the air battle. The information from the various sensors was still distributed piecemeal to various command centers, and no one center had either total responsibility for all air operations, or the technical capability to integrate and display all the incoming data. As a result, execution was appropriately decentralized to lower-echelon units closer to the battle.

Twenty years later during Operation Desert Storm, significant improvements were available to the TACC. First, a streamlined command structure placed a JFACC directly in control of all theater air assets and allowed for centralized control of the air campaign. A single command center directed all air efforts and planned strike missions. Technological improvements allowed the display of on-going air missions, but such displays were still unreliable. Once again, radar and SIGINT information played important roles in monitoring mission execution; but by 1991, the majority of these sensors had migrated to airborne platforms with improved data-link capabilities that shared information with the TACC. Space systems also began to provide real-time information to the theater and allowed operators to re-direct airborne missions onto high-priority, Time Critical Targets (TCTs). While information and communications capabilities had significantly improved, analytic capabilities on how to best use that information had not kept pace. Lack of detailed information on target locations and assessments of ongoing strike missions precluded the TACC from exercising further control of mission execution.

In 1999, Operation Allied Force demonstrated the limits to which improved sensor and communications capabilities allowed centralized execution of air operations. New sensor systems in the form of Unmanned Aerial Vehicles (UAVs), which could transmit imagery directly back to the Combined Air Operations Center (CAOC) were

widely used. Airborne sensors were able to link their information effectively to the CAOC, which was then able to display the combined data from a variety of sources on a common system. In many instances this capability gave the CAOC much more extensive information on local conditions within the battle area than even the strike aircraft themselves. An analytical element in the form of a flex-targeting cell was able to correlate the information and make timely decisions on the use of airpower against TCTs and transmit the information to strike aircraft. Extensive communications capabilities provided the CAOC with the ability to communicate to any airborne aircraft and to transmit decisions in real time, as well as to monitor the ongoing mission. The combined improvements in sensors and communications capabilities allowed the air commander to direct execution of the air campaign from a centralized facility.

The fact that technological capabilities give a JFACC the ability to execute certain operations of an air campaign centrally does not lead to the conclusion that this represents the correct approach to waging war. Feasibility does not necessarily imply desirability. Uncertainties and doubts about the accuracy of the information will abound; the fog of war will remain as long as human beings remain integral to the decision-making process. In certain types of operations, where a high degree of control is required over the application of force, or in smaller operations where the tempo is not high (perhaps less than 200 sorties per day), JFACCs may reserve much more authority for themselves and the AOC in the use of force. They may thus centrally direct the execution of many missions. As forces build and the tempo of operations concurrently increases, much more decision making may devolve back either to on-scene units, or to those with the best available information.[188] As Operation Allied Force demonstrated, however, the same technological capabilities may also move the centralized control of airpower to levels of command and decision making above the level of a JFACC, a move that would reduce the many hard-fought gains made in recent doctrine.

Implications for the AOC as a Weapons System

On 8 September 2000, Chief of Staff of the Air Force, General Michael Ryan, officially declared the AOC to be a weapons system.[189] In making this declaration, General Ryan set a goal for the AOCs to be staffed by trained personnel who understood

not only how to establish and maintain all of the various systems within an AOC, but also understood how to employ such a system in wartime, much as an aircraft has maintenance personnel to keep it running and a pilot to fly it on its missions. During Desert Storm and Allied Force the AOCs involved were quickly overwhelmed by the arrival of personnel representing different weapons systems, few of whom had any training in working in an AOC. This "pick-up" game mentality created problems for the smooth functioning of the AOC, as valuable time was spent training these often temporary-duty (TDY) personnel in operating the various systems within the AOC, as well as learning the procedures of both Combat Operations and Combat Plans.[190]

As of this writing, the US Air Force is fully committed to improving the ability of the AOC to function as a weapons system. A key concept driving the performance of the entire TACS is the ability to find, fix, track, target, engage, and assess (F2T2EA) targets within a theater.[191] Linked to the concept of Information Superiority, F2T2EA strives to "pull together sensor data from many different platforms, overlay it, and create a comprehensive digital picture of the battlespace where every threat is clearly visible and the commander can focus on how best to use his forces and coordinate with others."[192] In addition to sensor information driving the decision-making capability of the AOC, improved communications are also part of the process. The most recent Air Force Science & Technology Plan describes the Global Grid as the key enabling technology ensuring communications connectivity for the future:

> Airborne and spaceborne assets require large bandwidth to facilitate the movement of time-critical information across dynamic communications links and networks with secure survivable network protocols. The Air Force will require a fully and seamlessly interconnected network of communications resources to provide assured information flows to, from, and within the battlefield. The Global Grid is a virtual, multi-dimensional grid of interconnected information and communications systems that makes possible global connectivity for C2 elements and organizations.[193]

The end goal for these technologies is a concept known as Dynamic Command and Control (DC2). According to the Science and Technology Plan. DC2 involves:

> Three key information technologies…They are knowledge-based planning and scheduling, high performance knowledge bases, and intelligent agent-based systems. Combined they provide the capability to effectively use information in a continuous planning and scheduling environment. This

> will create the dynamic environment necessary to improve situational awareness, decrease re-planning response time, and provide accurate asset tracking with a greater number of plan options.[194]

With ubiquitous ISR assets linking critical, real-time information on the enemy's actions and possible intentions, high-speed computers able to assist AOC operators in both analysis and decision-making, and robust communications allowing the AOC to link the decisions to strike aircraft, the aspiration for such capabilities is to reduce the F2T2EA cycle for time-critical targets to "single digit minutes" for execution.[195]

When the vision is realized, information will not allow only rapid decisions and engagement of desired targets, but the information itself will be distributed both in and outside of the theater. These distributed operations are intended to allow a reduced forward presence for the AOC itself. As information or particular decisions are needed, "Reachback" operations will allow inter- and intra-theater entities to support the campaign.[196] In essence, the resources available to the JFACC and his staff will expand to include nearly any entity that has the capability to access the Global Grid. In fact, the very idea of a staff may evolve to specialists interacting not by virtue of collocation with the commander, but in their ability to connect into the Global Grid.[197] Physical proximity to the AOR will no longer limit either the ability to monitor the battlespace or to make decisions based on the available information. As information is required, users can acquire it from the desired source or, with the advent of sufficiently advanced computer algorithms, the needed information can be pushed to the appropriate user.

Chapter 1 of this thesis stressed the importance of perspective when examining the level of centralized or decentralized execution by using Close Air Support (CAS) as an example. CAS, when viewed from the cockpit of a strike aircraft, is a highly centralized mission, as information on local conditions is not only relayed to the pilot, but detailed instructions on how he is to perform that mission is also given by an on-scene element. From the perspective of the theater commander, the CAS system is highly decentralized because it is in the hands of those on-scene with the best information. With advances in sensor and communication technologies now giving the AOC perhaps much better information on the forward battle area, the lines of decentralization become blurred. If the same information relayed by a FAC to a CAS aircraft is now sent from an AOC, has the operation become centralized?

Decentralized execution may then best be viewed as a matter of decision-making authority. If the goal is to use the AOC as a weapons system to communicate the intent of the JFACC to aircraft that are capable of striking targets, the entities with the best available information on the desired target *and its effect on the overall campaign objectives* can authorize the engagement. In the past, on-scene commanders, with the best information on local conditions, had this authority to allow for better responses to changing battlefield conditions. As the size of operations have grown, and with airpower's ability to influence simultaneous events across an entire theater against tactical, operational, and strategic targets, the information has become centralized at command centers that have access to much more information on, not only local conditions, but on the overall theater as well. In operations such as Allied Force, organizations like the CAOC reserved much more decision-making authority, perhaps due to the limited size of the operation and to the sensitivities of coalition partners to bombing certain targets.[198] The key to determining the future validity of decentralized execution for air operations then becomes the degree to which technology allows information to become centralized in a single organization, or distributed throughout the theater and into the hands of the operators that are given the authority to execute the JFACC's intent.

Bibliography

Books

Air Force CONOPS IV: Modernization of the USAF Theater Air Control System (TACS) Analysis, 2nd draft. Washington D.C.: Synergy, Inc. 29 September 2000.

Air Force Doctrine Document (AFDD) 1. Air Force Basic Doctrine. September 1997.

Air Force Manual (AFM) 1-1. United States Air Force Basic Aerospace Doctrine. 14 August 1964.

———. United States Air Force Basic Aerospace Doctrine. 28 September 1971.

———. United States Air Force Basic Aerospace Doctrine. 15 January 1975.

———. Functions and Basic Doctrine of the United States Air Force. 14 February 1979.

———. Basic Aerospace Doctrine of the United States Air Force. 16 march 1984.

———. Basic Aerospace Doctrine of the United States Air Force Volume I. March 1992.

———. Basic Aerospace Doctrine of the United States Air Force Volume II. March 1992.

AFM 2-7. Tactical Air Force Operations: Tactical Air Control System (TACS). 5 June 1967.

———. Tactical Air Force Operations: Tactical Air Control System (TACS). 25 June 1973.

Air Force Command and Control: The Path Ahead, Volume 1: Summary. Washington D.C: United States Air Force Scientific Advisory Board. December 2000.

Alberts, David S. and Richard Hayes. Command Arrangements for Peace Operations. Washington D.C.: National Defense University Press, 1995.

Alford, Stefan. "AOC Declared Official Weapons System." US Air Force News Release. 12 September 2000.

Allard, Kenneth C. Command, Control, and the Common Defense. New Haven: Yale University Press, 1990.

Allison, Graham T. Essence of Decision: Explaining the Cuban Missile Crisis. Boston, MA: Little, Brown, 1971.

Andriole, Stephen J. Advanced Technology for Command and Control Systems Engineering. Fairfax, VA: AFCEA International Press, 1990.

Arquilla, John, and David Ronfeldt. Preparing for Conflict in the Information Age. Santa Monica: RAND, 1997.

Beaumont, Roger. The Nerves of War: Emerging Issues in and references to Command and Control. Washington D.C.: AFCEA International Press, 1986.

Blair, Bruce Strategic Command and Control. Washington D.C.: Brookings Institute Press, 1985.

Boyes, John L. ed. Issues in C3I Program Management. Washington D.C.: AFCEA International Press, 1984.

Britten, Scott M. Reachback Operations for Air Campaign Planning and Execution. Maxwell AFB, AL: Air War College Center for Strategy and Technology, 1997.

Builder, Carl, Steven C. Bankes, and Ricahrd Nordin. Command Concepts: A Theory Derived from Practice. Washington D. C.: RAND, 1999.

Cardwell, Thomas A. Command Structure for Theater Warfare: The Quest for Unity of Command. Maxwell AFB, AL: Air University Press, 1984.

Castle, Timothy N. One Day too Long: Top Secret Site 85 and the Bombing of North Vietnam. New York: Columbia University Press, 1999.

Chapman, William G. Organizational Concepts for the Sensor to Shooter World. Maxwell AFB, AL: Air University Press, 1997.

Coakley, Thomas P. Command and Control for War and Peace. Washington D.C.: National Defense University Press, 1992.

———. ed. C3I: Issues of Command and Control. Washington D.C.: National Defense University Press, 1991.

Clodfelter, Mark. The Limits of Airpower. New York: The Free Press, 1989.

Cooling, Benjamin F. ed. Air Superiority. Washington D.C.: Government Printing Office, 1994.

Costello, Peter A. A Matter of Trust: Close Air Support Apportionment and Allocation for Operational Level Effects. Maxwell AFB, AL: Air University Press, 1997.

Coyne, James P. Airpower in the Gulf. Arlington, VA: Aerospace Education Foundation, 1992.

Creveld, Martin Van. Command in War. Cambridge, MA: Harvard University Press, 1985.

Cushman, John H. Command and Control of Theater Forces: Adequacy. Washington D.C.: AFCEA International Press, 1985.

Desert Storm Command and Control. Maxwell AFB, AL: USAF Historical Research Agency, K417.054-72.

Evolution of U.S. Strategic Command and Control and warning, 1945-1972. Alexandria, VA: Institute for Defense Analysis, Jun 1975. (M-U 40381-7 #467).

Fischer, Michael E. Mission-Type Orders in Joint Operations: The Empowerment of Air Leadership. Maxwell AFB, AL: Air University Press, 1995.

Fuller, J.F.C. Generalship: Its Diseases and Their Cure. Harrisburg, PA. Military Services Publishing, 1936.

Futrell, Robert F. Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force 1907 - 1960 Volume I. Maxwell AFB, AL: Air University Press, 1989.

———. Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force 1961 - 1984 Volume II. Maxwell AFB, AL: Air University Press, 1989.

———. The United States Air Force in Southeast Asia: The Advisory Years to 1965. Washington D.C.: Office of Air Force History, 1981.

Gaines, R. S., Willard E. Naslund, and Ralph Strauch. Combat Operations Decisionmaking in Tactical Air Command and Control. Santa Monica, CA: RAND, December 1980

Gerber, David K. Adaptive Command and Control of Theater Airpower. Maxwell AFB, AL: Air University Press, 1999.

Griffin, Gary B. The Directed Telescope: A Traditional Element of Effective Command. Ft Leavenworth, KA: Combat Studies Institute, 1991

Grin, John. Military-Technological Choices and Political Implications: Command and Control in Established NATO Posture and a Non-Provocative Defence. New York: St. Martin's Press, 1990.

Hamre, John J. Strategic Command, Control, and Communications Alternative Approaches for Modernization. U.S. Congress Washington D.C. Congressional Budget Office, 1981.
Hanser, Lawrence M., Martine Leed, and C. Robert Roll, The Warfighting Capacity of Air Combat Command's Numbered Air Forces. Santa Monica: RAND, 2000.
Harshberger, Edward R. and Richard Mesic. A Vision of Theater Air Defense Battle Management and Control in 2010. Santa Monica: RAND, 1998.
Howard, Michael. War in European History. Oxford: Oxford University Press, 1976.
Huber, Arthur F. et al. The Virtual Combat Air Staff: The Promise of Information Technologies. Washington D.C.: RAND, 1996.
Hughes, Daniel J. ed. Moltke on the Art of War: Selected Writings. Translated by Daniel J. Hughes and Harry Bell. Novato, CA: Presidio Press, 1993.
Hughes, Thomas A. Overlord: General Pete Quesada and the Triumph of Tactical Air Power in World War II. New York: The Free Press, 1995.
Johnson Stuart E., and Alexander Levis, ed. Science of Command and Control: Coping With Uncertainty. Washington D.C.: AFCEA International Press, 1988.
Joint Publication 3-56.1. Command and Control for Joint Operations. Washington, D.C.: US Government Printing Office. 14 November 1994.
Joint Publication 3-01.2. Joint Doctrine for Theater Counterair Operations. Washington, D.C.: US Government Printing Office. 1 April 1986.
Joint Vision 2010. Washington, D.C.: US Government Printing Office. 1996.
Kahan, James P., et al. Understanding Commander's Information Needs. Santa Monica: RAND, 2000.
Keany, Thomas A. and Eliot A. Cohen. Revolution in Warfare? Airpower in the Persian Gulf War. Annapolis: Naval Institute Press, 1993.
Kosovo/Allied Force After Action Report: Report to Congress. Washington D.C.: US Government Printing Office. 31 January 2000.
Lane, John J. Command and Control and Communications Structures in Southeast Asia. Maxwell AFB, AL. Air University Press, 1981.
Levis, Alexander H, and Ilze Levis, ed. Science of Command and Control: Part III Coping With Change. Washington D.C.: AFCEA International Press, 1994.
Luvaas, Jay. Napoleon on the Art of War. New York: The Free Press, 1999.
Mandeles, Mark D., Thomas C. Hone, and Sanford S. Terry. Managing "Command and Control" in the Persian Gulf War. Westport, CT: Praeger Publishers, 1996.
Marine Corps Doctrinal Publication 6. Command and Control. 4 October 1996.
Mark, Eduard. Aerial Interdiction in Three Wars. Washington D.C.: Center for Air Force History, 1994.
Marshall, Samuel L.A. Men Against Fire: The Problem of battle Command. Norman, OK: University of Oklahoma Press, 2000.
McCarthy, James R. and George B. Allison. Linebacker II: A View from the Rock. Maxwell AFB, AL: Airpower research Institute, 1979.
McNamara, Stephen J. Air Power's Gordian Knot: Centralized Versus Organic Control. Maxwell AFB, AL: Air University Press, 1994.
Momyer, William W. Air Power in Three Wars. Washington D.C.: Government Printing Office, 1978.

Mrozek, Donald J. Air Power and the Ground War in Vietnam: Ideas and Action. Maxwell AFB, AL: Air University Press, 1988.
Murray, Williamson, Air War in the Persian Gulf. Baltimore: The Nautical & Aviation Publishing Company of America, 1995.
Orr, G.E. Combat Operations C3I: Fundamentals and Interactions. Maxwell AFB, AL: Air University Press, 1983.
Pape, Robert A. Bombing to Win: Air Power and Coercion in War. Ithaca, NY: Cornell University Press, 1996.
Paret, Peter, ed. Makers of Modern Strategy: From Machiavelli to the Nuclear Age. Princeton: Princeton University Press, 1986.
Proceedings of the First International Symposium on Command and Control Research and Technology. National Defense University Press, 1995.
Project CHECO, Linebacker Operations: September – December 1972. Maxwell AFB, AL: USAF Historical Research Agency, K717.0413-102, Sept-Dec, 1972.
Project CHECO, Seventh Air Force TACTICAL AIR CONTROL CENTER Operations. Maxwell AFB, AL: USAF Historical Research Agency, M-U 38245-74, 15 Oct 68.
Project CHECO, Single Manger for Air in SVN. Maxwell AFB, AL: USAF Historical Research Agency, M-U 38245-62, 18 Mar 69.
Project CHECO, Southeast Asia Tactical Data Systems Interface. Maxwell AFB, AL: USAF Historical Research Agency, K717.0414-51 1 Jan 75.
Project CORONA HARVEST, History of USAF Close Air Support Command & Control. Maxwell AFB, AL: USAF Historical Research Agency, M-U 41737-252, 1 May 1973.
Project CORONA HARVEST, Command and Control of Southeast Asia Air Operations, 1 January 1965 – 31 March 1968. Maxwell AFB, AL: USAF Historical Research Agency, TS-HOA-73-47.
Raines, Edgar F. and David R. Campbell. The Army and the Joint Chiefs of Staff: The Evolution of Army Ideas on the Command, Control, and Coordination of the U.S. Armed Forces, 1942-1985. Washington D.C.: U.S. Army Center of Military History, 1986.
Rockwell, James M., ed. Tactical C3 for Ground Forces. Washington D.C.: AFCEA International Press, 1985.
Smith, John T. The Linebacker Raids. New York: Sterling Publishing, 1998.
Snyder, Frank M. Command and Control: The Literature and Commentaries. Washington D.C.: National Defense University Press, 1995.
Task Force IV: ACE Team. Maxwell AFB, AL: USAF Historical Research Agency, TF4-12-216, July 1992.
The Air Campaign Against Iraq. Maxwell AFB, AL: USAF Historical Research Agency, K239.047-34, Jan-mar 1991.
The Air Force Science & Technology Plan Fiscal Year 2000. Washington D.C.: US Government Printing Office, 2000.
Thompson, Wayne. To Hanoi and Back: The U.S. Air Force and North Vietnam, 1966-1973. Washington D.C.: Smithsonian Institution Press, 2000.
Understanding Link-11. San Diego, CA: Logicon, Inc., 1991.
Wainstein, L., et al. The Evolution of U.S. Strategic Command and Control and Warning, 1945 - 1972. Alexandria, VA: Institute for Defense Analysis, June 1975.

War Department Field Manual (FM) 100-20. Command and Employment of Air Power. 21 July 1943.

Watson-Watt, Robert. The Pulse of Radar. New York: The Dial Press, 1959.

Winnefeld, James A. and Dana J. Johnson. Joint Air Operations. Santa Monica, CA: RAND, 1993.

Witt, Randy, ed. Air Force Tactical Communications in War: The Desert Shield/Desert Storm Comm Story. Maxwell AFB, AL: USAF Historical Research Agency, K178.80-169, Feb 90-Mar-91.

Wohl, Joseph G. Battle Management Decisions in Air Force Tactical Command and Control, Maxwell AFB, AL: USAF Historical Research Agency, M-U 4156-26 1980 no 123.

Woods, David L. A History of Tactical Communications Techniques. Orlando, FL: Martin-Marietta Corporation, 1965.

Woodward, Bob. The Commanders. New York: Simon and Schuster, 1991.

Articles

Buchanan, Thomas H. "The Need for Battle Managers in the Tactical Air Control System." *Airpower Journal* (Summer 1987): 60-71.

Foster, Gregory D. "Contemporary C2 Theory and Research: The Failed Quest for a Philosophy of Command." *Defense Analysis* 4, no. 3 (1988): 201-228.

Griggs, Roy A. "Technology and Strategy." *Airpower Journal* 10, no. 2 (Summer 1996): 105-114.

Hazlegrove, Allen P. "Desert Storm Time-Sensitive Surface Targeting: A Successful Failure or a Failed Success?" *Defense Analysis* 16, no.2 (August 2000): 113-150.

Holley, I.B. "Command, Control, and Technology." *Defense Analysis* 4, no. 3 (1988): 267-286.

Knight, C. E. "Solving the Interoperability Problem." *Signal* 40, no. 3 (November 1985): 19-22.

Lewis, Richard B.H. "JFACC Problems Associated With Battlefield Preparation In Desert Storm." *Airpower Journal* 8, no.1 (Spring 94): 4-21.

Locher, James R. III, "Taking Stock of Goldwater-Nichols," *Joint Forces Quarterly* 13 (Autumn 96) 10-16.

Loomis, Richard T. "The White House Telephone and Crisis Management." *U.S. Naval Institute Proceedings* 95, no. 12 (December 1969): 63-72.

McKenzie, Duncan, "U.S. Air Force Communications in Desert Storm," *IEEE Communications* 30, no. 1 (Jan 1992): 42-44.

Nelson John T. "*Auftragstaktik*: A Case for Decentralized Battle." Parameters (September 1987): 21-34.

Rechtin, Eberhardt "The Technology of Command." *Naval War College Review* (Jan-Mar 1984): 5-25.

Showalter, Dennis. "The Influence of Railroads on Prussian Planning for the Seven Weeks' War." *Military Affairs* XXXVIII, no. 2 (April 1974): 62-67.

———. "Soldiers into Postmasters? The Electric Telegraph as an Instrument of Command in the Prussian Army." *Military Affairs* XXXVII, no. 2 (April 1973): 48-52.

Strickland, Paul C. “USAF Aerospace Power: Decisive or Coercive?” *Aerospace Power Journal* XIV, no. 3, (Fall 2000): 13-25.

Tirpak, John. “Short's View of the Air Campaign.” *Air Force Magazine* 82, no. 9, (September 1999): 43-47.

———. “Find, Fix, Track, Target, Engage, Assess,” *Air Force Magazine* 83, no. 7, (July 2000): 24-29.

Ware, Hugh, “New Tools for Crisis Management.” *U.S. Naval Institute Proceedings* 100, no. 8 (August 1974): 19-24.

White, John P. “Defense Organization Today.” *Joint Forces Quarterly* 13 (Autumn 96) 18-22

Wilt, Alan F. “Coming of Age: XIX TAC’s Roles During the 1944 Dash Across France.” *Air University Review* XXXVI, no. 3 (Mar-Apr 1985): 74-87.

Unpublished Papers

Baldree, Steven W. “The Positive Aspects of Network Centric Warfare: The Ties Between Behavioral Doctrine and Technology.” Research Paper, Naval War College, 1999. (Air University Library, M-U 41662B178P).

Dixon, Howard L. “The Impact of Technology on the Future of the Tactical Air Control System.” Research Paper, Air Command and Staff College, 1977. (Air University Library, M-U 43122D621I).

Harper, Dennis M. “Management of Tactical Strike Sorties in Southeast Asia.” Research Paper, Air Command and Staff College, 1971 (Air University Library, M-U 35582.7 H2932M).

Rogers, Donna M. “Centralized Versus Decentralized Command of Defensive Information Operations Within the Department of Defense.” Research Paper, Air Command and Staff College, 1999 (AFHRA M-U 43122R725C).

Saling Jeffrey M. “Dynamic re-tasking: The JFACC and the Airborne Strike Package.” Research Paper, Air Command and Staff College, 1999. (Air University Library, M-U 43122S165D).

Waldrop, Thomas L. “The Tactical Air Control System: 1985 and Beyond.” Research Paper presented at Air University, Airpower Symposium Maxwell AFB, AL, 13-15 February 1978. (Air University Library, M-U 42764-141TT).

Electronic Media

Hines, Jay E. “Confronting Continual Challenges: A Brief History of the United States Central Command**,”** lecture 2nd International Conference of Saint Leo College's Center for Inter-American Studies, 19 March 1997, n.p. On-line. Internet, 1 May 2001. Available from http://www.centcom.mil/what%20is/history.htm.

Jumper, John P., *AFA Air Warfare Symposium 2000,* Orlando, Florida 15 February 2001, n.p. On-line. Internet, 15 May 2001. Available from, http://www2.acc.af.mil/library/speeches/cc/010215.html

Katzaman, Jim. *“*Joint Vision 2010…The Way Ahead” *Air Force News,* 3 September 1996, n.p On-line. Internet, 1 May 2001. Available from http://www.af.mil/news/Sep1996/n19960903_960875.html.

Scherrer, Joe, “The Role of C2 Systems During NATO Operation Allied Force”, 20 September 99, n.p. On-line. Internet, 1 June 2001. Available from http://public.afca.scott.af.mil/public/99sep/sep20.html.

Short, Michael *AFA Air Warfare Symposium 2000*, February 25, 2000, On-line. Internet, 25 May 2001. Available from http://www.aef.org/symposia/short200.html.